RUGGLES CENTER

Final Environmental Impact Report
EOEA No. 6133

October, 1989

Prepared for:

METROPOLITAN/COLUMBIA PLAZA VENTURE
200 STATE STREET - 12TH FLOOR
BOSTON, MASSACHUSETTS 02109

Prepared By:

KRAMER ASSOCIATES • 80 Hovey Street • Watertown, MA 02172

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Consulting Team

The Final Environmental Impact Report for Ruggles Center was prepared for Metropolitan/Columbia Plaza Venture by a consulting team composed of the following groups:

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Distribution List

The following State and City agencies and other interested parties listed below have received a copy of this Final Environmental Impact Report:

State Agencies

Executive Office of Environmental Affairs
MEPA Unit
Department of Environmental Quality Engineering
Executive Office of Communities and Development
State Clearinghouse
Department of Community Affairs
Executive Office of Transportation and Construction
Governor's Office of Economic Development
Massachusetts Bay Transportation Authority
Massachusetts Aeronautics Commission
Massachusetts Department of Public Works
Massachusetts Historical Commission
Massachusetts Water Resources Authority
Metropolitan District Commission
Metropolitan Area Planning Council

City Agencies

Boston Redevelopment Authority
Office of the Mayor
Mayor's Office of Jobs and Neighborhood Services
Boston Housing Authority
Boston Transportation Department
Boston Water and Sewer Commission
Boston Public Works Department
Boston Parks and Recreation Department
Boston Department of the Environment
Boston Landmarks Commission
Boston Air Pollution Control Commission

Institutions and Individuals

Parcel 18+ Development Task Force
Northeastern University
Community Development Corporation of Boston
Greater Roxbury Community Development Corporation
Roxbury Action Program

Roxbury Community College
Roxbury Neighborhood Council
Greater Roxbury Neighborhood Authority
Mission Hill Tenants Task Force
Dudley Terminal Merchants Association
United South End Settlements
Whittier Street Health Center
First Church of God
Madison Park Development Corporation
Hattie Dudley
James F. Guilford
Mary Ann Nelson
Paul Parks and Associates, Inc.
Richard Heath

Project Summary

A. Factsheet

Project: Ruggles Center (Formerly, Parcel 18)

EOEA Number: 6133

Project Proponents: Ruggles Center Joint Venture

Scope of FEIR

The Final Environmental Impact Report (FEIR) presents the environmental impacts associated with the Master Plan Design, the preferred alternative for development of Ruggles Center. The report contains a detailed discussion of the project and plans for mitigation. To adequately address critical aspects of the project, additional analysis was performed in the following areas of environmental concern: transportation impacts; demand for utilities; massing and shadows; wind; open space; construction; and, hazardous substances.

The FEIR identifies permits required for the project, mitigation measures needed, and the parties responsible for implementing mitigation. Also included are responses to comments on the Draft Environmental Impact Report (DEIR) submitted to the Executive Office of Environmental Affairs (EOEA) and the Boston Redevelopment Authority (BRA).

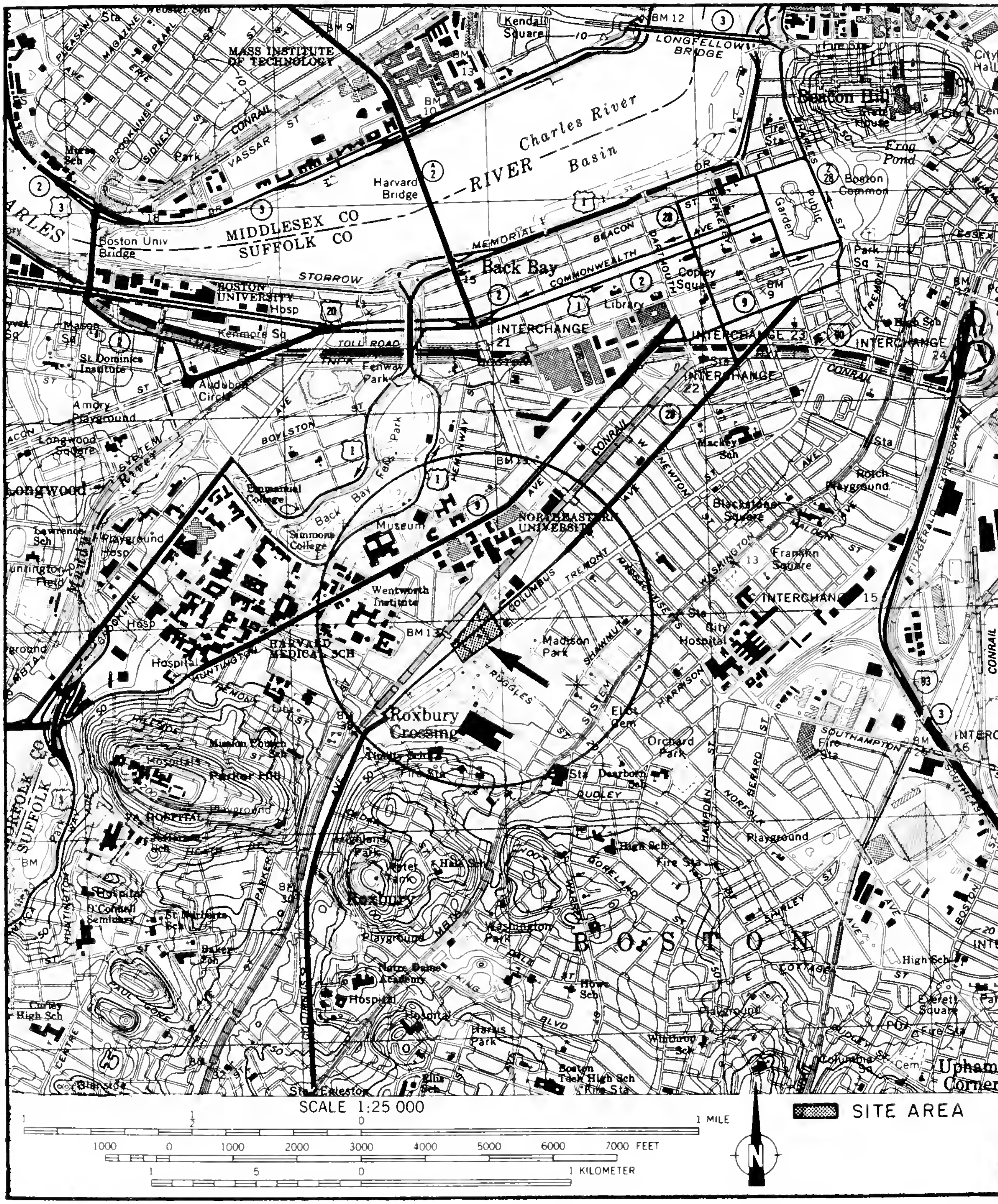
Site Description

The Ruggles Center site is located approximately two miles southwest of downtown Boston. The site consists of 5.10 acres located in Roxbury on a parcel bounded by Ruggles Street, Tremont Street, Melnea Cass Boulevard and land owned by the Massachusetts Bay Transportation Authority (MBTA). The site is also adjacent to the recently constructed Ruggles Street Station and is one of the largest tracts of vacant land along the Southwest Corridor.

Project Description

Ruggles Center is considered a keystone to the revitalization of the Ruggles Street area and completion of the Southwest Corridor Project. The project is a commercial mixed-use development. The Master Plan Design calls for five buildings that will contain office space, retail shops, a hotel and restaurant, as well as on-site parking (above ground and below grade). A central Plaza and network of open spaces and pedestrian walkways will provide easy access to the Ruggles Street Station, the Southwest Corridor Park and the neighborhood.

Figure I A-1 Location Map



The project will contain 968,175 square feet of developed floor area and 975 parking spaces. The tallest building has fifteen floors and stands 168 feet to the roof. In keeping with the traditional building materials used in Boston, the facades of the buildings will be constructed primarily of brick and pre-cast concrete panels with granite detailing. The central Plaza and remaining open space will be landscaped with trees and shrubs.

Construction Schedule

Ruggles Center is a phased development, beginning in 1990 and extending over a six year period. Phase 1 includes construction of Building 2, the above ground parking garage (Building 5), and the central Plaza. In the next phase, Building 1 will be built, followed by Buildings 3 and 4.

Employment Impacts

Ruggles Center will generate approximately 2,000 construction jobs and 3,000 permanent jobs.

Project Contributions

Many community benefits will flow directly from this project. Ruggles Center and its "linked" project, One Lincoln Street, are the City's first Parcel-to-Parcel Linkage project. Approximately $8.8 million of Housing Linkage Contribution and $1.75 million of Job Linkage Contribution will result from these two projects. Ruggles Center and One Lincoln Street will also serve as the catalyst for additional community benefits. These include: contributions to a proposed community development fund; promotion of employment; job training and job creation programs designed specifically to benefit minorities; a planning grant to the Parcel 18+ Development Task Force; establishment of a challenge grant to train minority candidates for management positions in the real estate industry; use of minority-owned enterprises for contracts related to the development of Ruggles Center; provision of technical assistance to minority-owned business enterprises; and, provision of child care facilities. Ruggles Center, when fully developed, will also pay to the City of Boston $1.75 million annually in real estate taxes.

B. Status of the Environmental Review Process

Because Ruggles Center is a major development, the Massachusetts Executive Office of Environmental Affairs (EOEA) determined that the project required the preparation of an Environmental Impact Report (EIR) in accordance with the Massachusetts Environmental Policy Act (MEPA) and its implementing regulations (301 CMR 11.00).

In July, 1986, the Boston Redevelopment Authority filed an Environmental Notification Form (ENF) with the EOEA which summarized the scope of socio-economic and environmental concerns raised by the proposed development of Ruggles Center (formerly referred to as Parcel 18). These concerns included:

- Transportation Impacts—traffic, pedestrian, mass transit, parking;
- Air Quality Impacts—motor vehicle emissions;
- Sewerage—new demand, adequacy of existing systems;
- Utilities—new demand, adequacy of existing supplies and distribution;
- Hazardous Substances—report on "21E" findings;
- Open Space—design, access, relationship to Southwest Corridor Park;
- Historic and Archeological Resources—presence and project impacts;
- Construction Impacts—truck traffic, noise, vibration, other construction in area;
- Massing and Shadows—massing options and shadow effects;
- Wind Impacts—existing conditions, proposed development, remedial measures;
- Social and Economic Conditions—existing situation, community benefits.

Many civic and private groups commented on the ENF. In response to the ENF and comments received, the EOEA defined a set of four development alternatives and the categories of impacts to be studied. After a developer was selected for Ruggles Center, the developer submitted a fifth alternative, which was also studied in the DEIR.

In March of 1989, the Boston Redevelopment Authority submitted the Draft EIR for Ruggles Center. The DEIR presented an environmental assessment of each development alternative. No preference for a particular alternative was made in order to allow the review process to evaluate alternatives on an equal basis.

EOEA circulated the draft for review and in May, 1989 issued a Certificate which specified the issues to be addressed in the Final Environmental Impact Report. Also included in that package were letters received by other reviewers of the DEIR.

The project proponent carefully reviewed the Certificate and comments made by reviewers. The design of Ruggles Center was modified to address many of the concerns raised. This Final Environmental Impact Report (FEIR) presents the environmental impacts associated with the Master Plan Design, the modified Developer's alternative. The report contains a detailed discussion of the project and plans for mitigation. To adequately address critical aspects of the project, additional analysis was performed in the following areas of environmental concern: transportation impacts; demand for utilities; massing and shadows; wind; open space; construction; and, hazardous substances.

The FEIR also identifies permits required for the project and presents Draft Section 61 Findings. Also included are responses to comments on the Draft Environmental Impact Report (DEIR).

C. Project Background

History

The Ruggles Center site is closely linked to a long history of transportation planning in the Boston region. The history of this project began in 1948 when the State proposed to extend Interstate Highway 95 down the Southwest Corridor, through Jamaica Plain and Roxbury, to downtown Boston. By 1956, the Federal Government approved funding for the I-95 extension, and ten years later families and businesses were displaced to clear land for the proposed highway. Boston residents, organized in protest, reversed the decision to build the highway. Instead, the funds were transferred for the construction of a rapid transit system. Residents and City and State officials worked together to create the Southwest Corridor Project which combined the building of a public transit system with the development of adjacent parcels created by land acquisitions for the highway. These parcels of land were identified by number and the MBTA enlisted community residents to plan for the development of the parcels. The largest of the parcels is the one associated with the Ruggles Street transit station – Parcel 18 (now called Ruggles Center).

The Parcel 18+ Development Task Force, including residents and City and State representatives, collaborated in the project. In 1985, Mayor Raymond Flynn, Governor Michael Dukakis, and the Task Force signed an agreement to link the development of Ruggles Center to that of a major downtown site -- the City-owned Kingston-Bedford garage (now called One Lincoln Street). That agreement established the BRA as the agent for the State, the City, and the MBTA in order to carry out the initial planning for the project.

Parcel-to-Parcel Linkage

Development of Ruggles Center in Roxbury and One Lincoln Street near Chinatown takes on added significance because it is Boston's first Parcel-to-Parcel Linkage Project. In 1985, the Flynn and Dukakis administrations introduced the concept of Parcel-to-Parcel linkage to:

(1) spread the benefits of development more evenly throughout Boston;
(2) promote neighborhood economic development; and
(3) increase opportunities for minorities to benefit from real estate development.

The program links the development of valuable, publicly-owned parcels downtown to the development of publicly-owned parcels in underdeveloped neighborhoods. It also requires that com-

munity organizations and minority developers and entrepreneurs become equity partners for the simultaneous development of both parcels.

Both projects of this first Parcel-to-Parcel Linkage Program will benefit surrounding communities. Ruggles Center will serve as a catalyst for creation of new jobs and community development in Roxbury; One Lincoln Street will enhance a markedly underused site within the Downtown and channel growth toward the Bedford-Essex Corridor.

In June of 1987, the City and State selected Columbia Plaza Associates (CPA) to be the minority development partner for both Ruggles Center and One Lincoln Street. Columbia Plaza Associates is a partnership of Asian-American, Black, and Hispanic investors. The partnership also includes community-based organizations as shareholders.

Columbia Plaza Associates, in turn, selected Metropolitan Structures as its partner from a field of three nationally prominent developers, and the two entities formed Metropolitan/Columbia Plaza Venture (MCPV). CPA holds a fifty percent equity position in the project, exceeding the thirty percent share required by the City. Subsequently, MCPV formed the Ruggles Center Joint Venture (RCJV)and the Kingston Bedford Joint Venture (KBJV) for purposes of developing Ruggles Center and One Lincoln Street.

Community Participation

The Parcel 18+ Development Task Force and Chinatown/South Cove Neighborhood Council have worked diligently with the BRA to develop the Parcel-to-Parcel Linkage Program and to advise the BRA on all aspects of these projects, including developer selection.

The Roxbury and Chinatown groups formed the Parcel-to-Parcel Linkage Advisory Panel. Also participating in the panel are: the BRA, the MBTA, the City of Boston Real Property and Public Facilities Departments, the Governor's Office of Economic Development, the Mayor's Office of Neighborhood Services, and the Mayor's Office of Jobs and Community Services. The panel has established subcommittees on:

(1) creation of affordable housing;
(2) jobs and jobs training;
(3) minority business enterprise;
(4) child care; and,
(5) the community development fund.

The MCPV has worked closely with the Advisory Panel to shape the direction of the two projects and, in particular, to refine a benefits plan for the communities.

Community Benefits

Numerous public benefits will be realized through these linked projects. In fact, the community benefits plan, when implemented, is the most wide-ranging in the city's history. It will encompass programs to build affordable housing, fund job training programs, stimulate minority business opportunities, and provide child care facilities. The major components of the plan are highlighted below.

Community Development Fund

In addition to contributing 10 percent of its developer's fee, the proponent of the Ruggles Center development will, over a period of 25 years, contribute to the Community Development Fund 5 percent of the development's net operating income and 10 percent of the refinancing proceeds, to the extent that there is net cash flow available.

In addition to contributing 10 percent of its developer's fee, the proponent of the One Lincoln Street development will pay to the Community Development Fund a total of $10 million over a ten-year period from commencement of construction.

The Ruggles Center and One Lincoln Street projects together will contribute $12 to $15 million to the Community Development Fund. Funds will be used to leverage local business expansion, affordable housing, social services, and other community-based projects in Chinatown and Roxbury.

Housing Linkage

The City of Boston requires that developers contribute $5 per square foot for commercial development projects over 100,000 square feet toward the creation of affordable housing. Development of Ruggles Center will generate a housing linkage contribution of approximately $4.5 million. The linkage contribution for each phase will be discounted to present value and paid up front as a lump sum payment at the start of each phase, as specified in the Development

Impact Project Agreement by and between the Ruggles Center Joint Venture and the Boston Redevelopment Authority.

Development of Ruggles Center and One Lincoln Street, together, will generate $8.8 million in housing linkage funds to be shared equally by Chinatown and Roxbury.

Jobs and Job Training

The Ruggles Center and One Lincoln Street projects are expected to generate 4,000 construction jobs. The developer will seek to achieve hiring goals of at least 50 percent of all construction jobs created (as measured by total employee hours) be held by Boston residents, 30 percent by minorities, and 10 percent by women.

The projects will eventually support 7,000 permanent jobs and generate $1.7 million in job training linkage funds for residents of Roxbury and Chinatown. (Developers are required to contribute to a job training fund of $1 per square foot for commercial developments over 100,000 square feet.) The RCJV and KBJV intend to apply the funds directly to the training of community residents for permanent employment opportunities in the projects. In addition, the Ventures will join the "Boston for Boston" program, a resident hiring program carried out by the Office of Jobs and Community Services, and will encourage project tenants to make best faith efforts to direct new jobs to local residents.

The benefits package also contains five other employment features. First, Kingston Bedford Joint Venture is offering a $400,000 challenge grant for on-the-job training in real estate development. Second, 30 percent of consultant contracts for both projects, estimated at $18.5 million, will be targeted to certified minority business enterprises (MBE). Third, both RCJV and KBJV have set as a minimum goal, the leasing of at least thirty (30) percent of the total retail space at both sites to neighborhood-based businesses and MBE's. Fourth, the RCJV will work with the Advisory Panel to develop a business incubator program to provide opportunities at relatively low costs for existing or start-up businesses. And finally, prior to and during construction, both RCJV and KBJV will provide either on-site or off-site employment centers to inform the public of available employment opportunities.

Child Care

Both RCJV and KBJV will also provide child care facilities for 100 children in Roxbury and 100 children in Chinatown. The facilities may be located on or off the project sites.

Planning Grant

The Metropolitan/Columbia Plaza Venture has contributed $36,000 to the Parcel 18+ Task Force and Chinatown Neighborhood Council to facilitate greater participation over the next two years in project planning and review. An additional $64,000 will be contributed by the Kingston Bedford Joint Venture, totalling $100,000 over a two year period.

Equity Participation by Community Non-Profit Organizations

Ten percent of Columbia Plaza Venture's interest will be held by community non-profit organizations. The Chinese Investment Limited Partnership has already donated 10 percent of its share of interest in CPA to the Chinese Consolidated Benevolent Association, a tax-exempt community umbrella organization.

D. Environmental Setting

Project Environs

Ruggles Center is located midway in the Southwest Corridor, approximately two miles southwest of downtown Boston. (See Figure I D-1.) The site is well situated. Adjacent to the site is the new Ruggles Street Station, the third largest station in the Southwest Corridor. Ruggles Station serves as a main transit transfer point in Roxbury. Currently, fourteen bus routes terminate at Ruggles Station. The Station is also a commuter rail stop.

The site also abuts four important traffic arteries: Tremont Street, Melnea Cass Boulevard, Ruggles Street, and Columbus Avenue. There is considerable through traffic traveling across town on these major streets. Convenient access to the Massachusetts Turnpike and the Southeast Expressway is nearby.

Several major institutions are nearby, including Northeastern University, Roxbury Community College, Wentworth Institute, the Museum of Fine Arts, Madison Park High School/Humphrey Resource Center, and the New England Conservatory of Music.

The project area is primarily a residential neighborhood, predominantly Black, with a growing Hispanic and Caribbean population. Major multifamily housing developments in the vicinity of the parcel include the Madison Park (LRCC) Houses, Roxse Homes, and the Mission Hill and Mission Hill Extension, Whittier Street, and Lenox Street public housing projects.

There are a few commercial establishments along Tremont Street and Columbus Avenue northeast of the project site. Most of the existing stores and service outlets are located in the Dudley Square business district, approximately one-half mile to the southeast. Some light industry is located along Melnea Cass Boulevard east of the site.

The area is in transition. Several nearby vacant parcels are either under construction or in the midst of development planning. Both commercial and residential development is anticipated. For example, the MBTA and the City are proposing a mixed-use development, accommodating between 150 and 200 housing units on Parcel 22, which is adjacent to Parcel 18. For Parcel P-3, across Tremont Street, a 650,000 sq. ft. office and retail development is proposed. Northeastern University is also expanding its library, and its athletic and parking facilities.

Other development in the area has just been completed or is

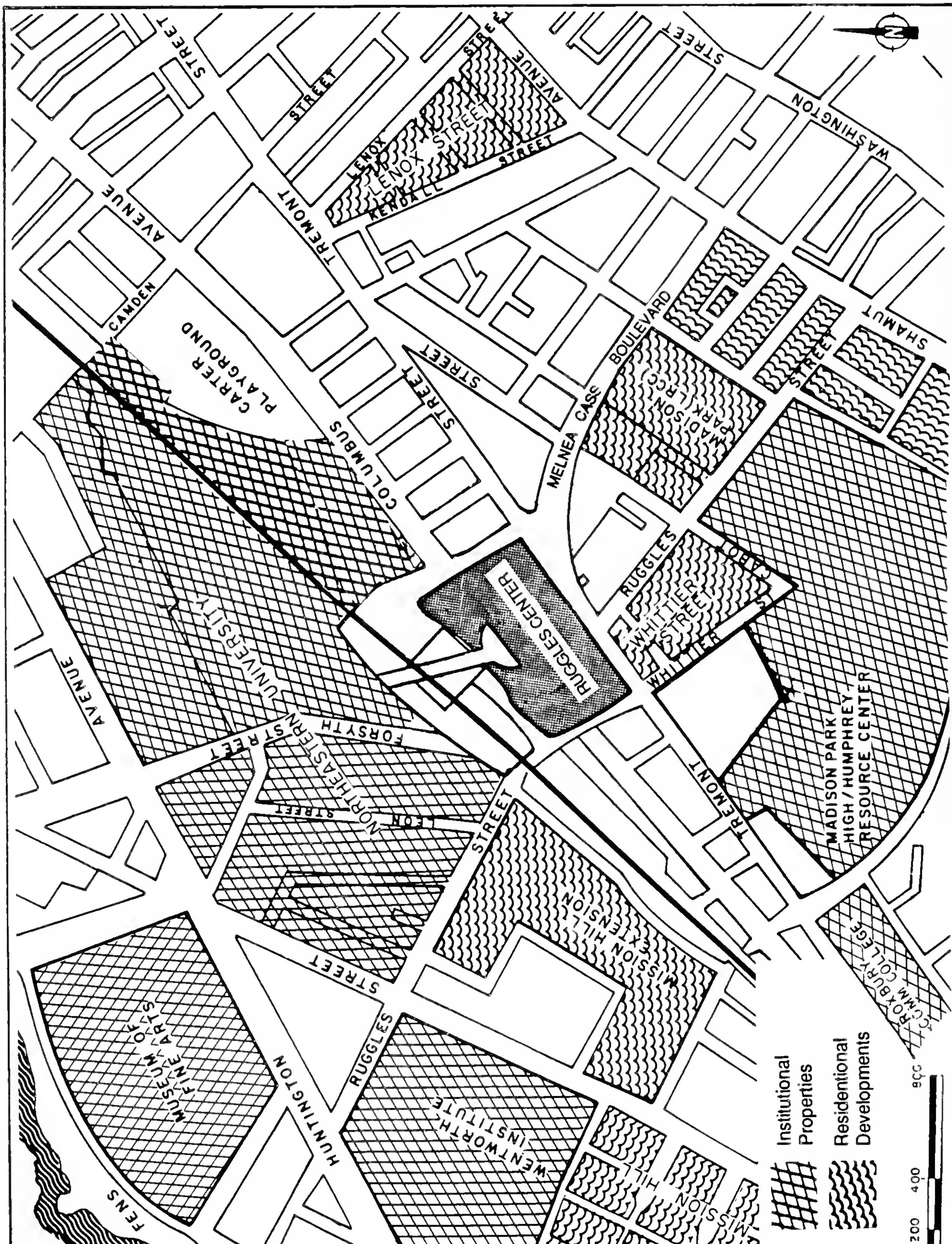


Figure I D-1 Area Surrounding Ruggles Center

nearly done. In 1988, Northeastern constructed a 995 car parking garage on Parcel 17. The MBTA completed the stretch of Southwest Corridor parkland that runs along the Columbus Avenue extension through the project site. South of the site on Columbus Avenue, the new campus for Roxbury Community College has opened. And finally, the Boston Housing Authority has nearly completed redevelopment of a major section of the Mission Hill Extension Housing Project.

Site Description

The Ruggles Center site is an aggregate development parcel of over 5.1 acres, or 222,296 square feet. It measures approximately 700 feet along the Tremont Street frontage by 225 feet in width. The MBTA owns most of the site. The City of Boston and the BRA also own certain subparcels.

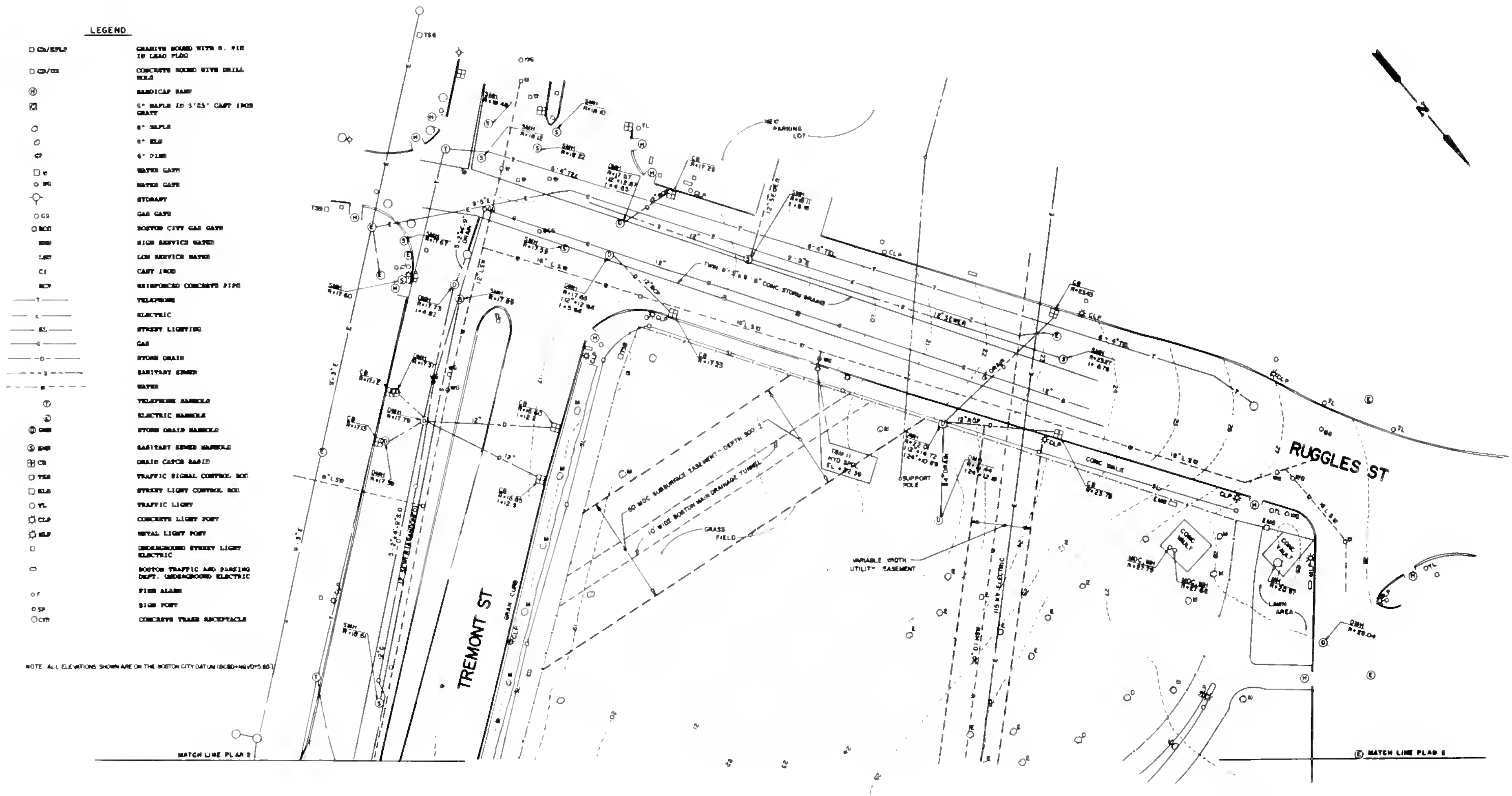
The site is unencumbered by any structures or permanent features that would require removal prior to construction. Until recently, it was used by Northeastern University for parking and by the MBTA as a staging area for the construction of the Ruggles Street Station.

The MBTA has constructed a kiss-and-ride drop-off circle on the site. Access to this drop-off point is via the Columbus Avenue Extension. Directly west of the station entry is a strip of parkland that runs to Ruggles Street. Currently a landscaped open space, the MBTA may locate a future bus lane in this area. The remainder of the parcel is covered with grass and a few small trees.

The rear of the site is contiguous with a portion of the Southwest Corridor Park. This park extends across the site as a paved pedestrian and bicycle path and is currently landscaped with benches, small trees and shrubs.

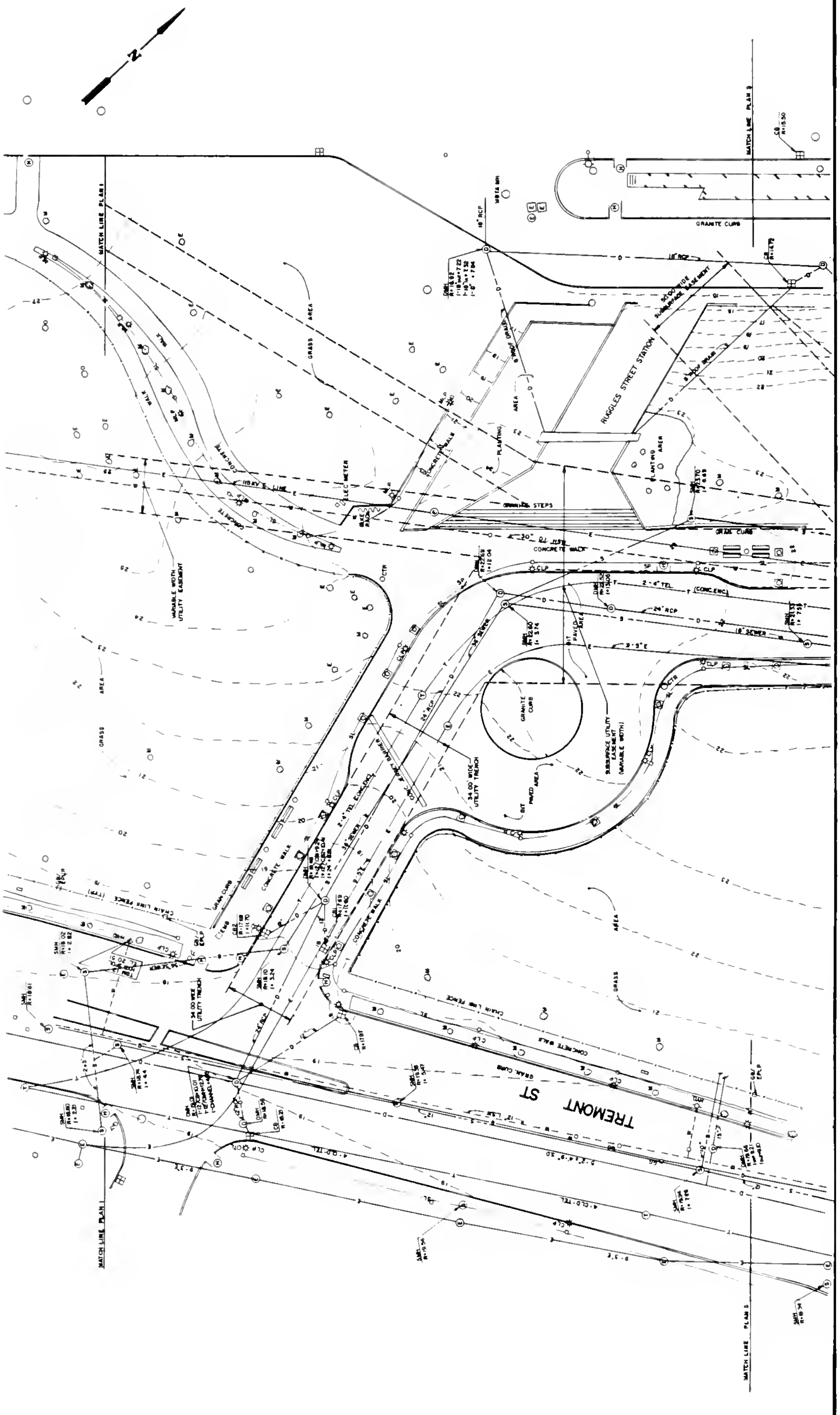
The site also contains several utility and MBTA easements (See Figures I D-2). A 115 KV electric duct bank and a 30-inch water line are located within the former Columbus Avenue alignment across the upper portion of the site. A portion of the 120-inch Boston Main Drainage Tunnel crosses beneath the site at the Ruggles Street/New Columbus Avenue intersection, and the 78-inch Main Drainage Relief Sewer passes from the drop-off circle to Ruggles Street.

The MBTA has long range plans to build a circumferential



EXISTING CONDITION
PLAN 1
SCALE 1"=20'

Figure I D-2 Existing Site Conditions and Easements

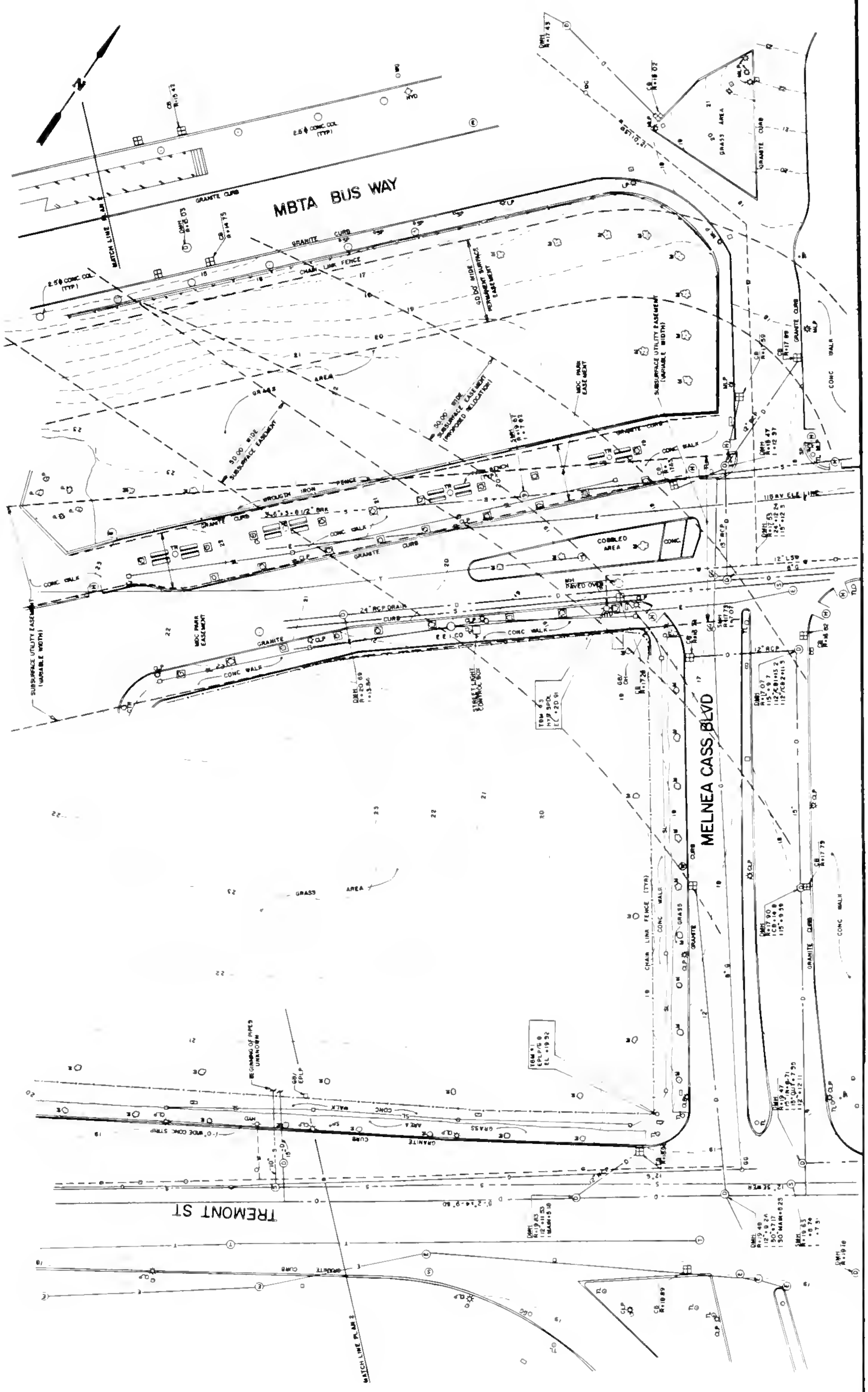


EXISTING CONDITION PLAN 2

SCALE 1"=20'

EXISTING CONDITION PLAN 3

SCALE 1"=20'



transit line that will encircle Boston. The transit mode and alignment have not been determined, except that the route would pass through the site. Therefore, the northern corner of the parcel has been reserved for a tunnel section in the event that a subsurface mode of transit is selected. A 40-foot wide surface easement also has been reserved in the event that the circumferential transit will operate above ground.

Site Conditions

Topography

Topographically, the site has a fairly gentle slope which averages about a three percent from front to rear. Located on former lowlands and tidal marshlands, the site has ground elevations ranging from +11.5 to +18 feet (NGVD).

Geology

The surficial geology of the site consists of unconsolidated materials, to a depth of approximately 150 feet, overlying a bedrock of Cambridge Argillite, a slaty siltstone. The deposits, from youngest to oldest, consist of heterogeneous clay-sand-gravel-rubble fill including perhaps abandoned foundations, organic silt with trace amounts of sand and peat, gravelly sand outwash deposits, a thick layer of stiff silty marine clay (varying from 60 to 130 feet), gravelly to silty sand outwash deposits, clayey to gravelly glacial till, and Cambridge Argillite bedrock.

According to settlement studies prepared by Haley and Aldrich, Inc., the marine clay deposits which underlie the entire site may be subject to long-term settlement problems and differential movements. As a consequence, in certain zones of the site, deep end-bearing piles may be required. (See Chapter II, Section F for a full discussion of construction impacts.)

Groundwater

Data available from Haley and Aldrich (1980) suggest that the groundwater elevation is approximately +2.0 NGVD. Assuming an average surface elevation of +13 feet, the average depth to groundwater on the site would be 11 feet.

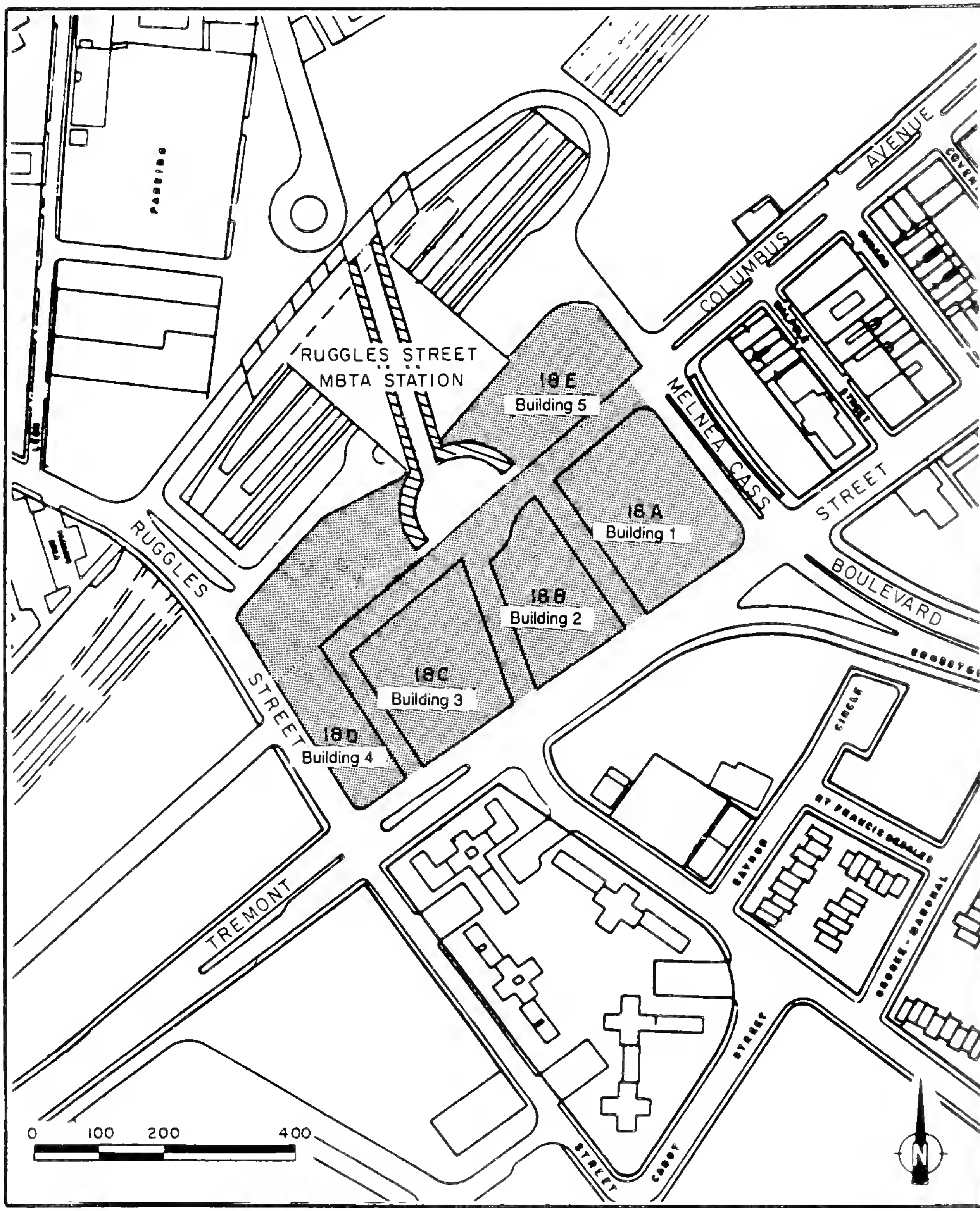


Figure I E-1
Building Sites and Parcelization

E. Project Description

Alternatives Considered

In the project's earliest stages, the Boston Redevelopment Authority established a set of design guidelines to ensure that the development of Ruggles Center meets the needs of the community and minimizes any adverse effects stemming from its implementation. The guidelines are presented in Table I E-1 and clearly show the urban design principles that governed the design.

Development was also guided by the available building sites. The site is an aggregate development parcel of over 5.1 acres. On the site, there are three large areas available for development. Figure I E-1 shows how these areas were subdivided into subparcels for five buildings.

To test the implications of different land uses and building designs, the BRA, in cooperation with the Parcel 18+ Development Task Force and the developer, suggested and investigated five design alternatives. The alternatives were:

Alternative 1:	No Build
Alternative 2:	19-Story Office Buildings
Alternative 3:	14-Story Office Buildings
Alternative 4:	9-Story Office Buildings
Alternative 5:	Developer's Proposal

Under the No Build option, the site would remain as is. Table I E-2 compares the land uses proposed for Alternatives 2 through 5. All "Build" alternatives featured a five building complex with commercial office space as the predominate use and underground parking beneath most of the complex. Alternatives 2, 3, and 4 tested the environmental effects of different height office buildings and thus are distinguished by the number of floors proposed for the two principal office buildings. These alternatives also contained a cultural center and 150-200 housing units. Alternative 5, the initial Developer's Proposal, presented a slightly different concept. The cultural center and housing units were replaced by a hotel and a central Plaza. There was also a child care facility and an above-ground parking structure in this alternative.

Master Plan Design

The analysis of alternatives and further site investigations resulted in refinement of the initial Developer's Alternative. This new design, now called the Master Plan Design dated June 1, 1989, is now

Table I E-1

BRA Design Guidelines for Ruggles Center

- Office Space as a primary use.
- Commercial use of ground floors in all buildings except structures proposed for housing development.
- Space allocation for community functions and day care facilities.
- Maximum building height of 225 feet.
- Materials and architectural features that provide a sense of human scale and reflect street and block layout compatible with Boston's South End.
- Buildings constructed to the edge of the sidewalks along Tremont Street, Ruggles Street, Melnea Cass Boulevard, and Columbus Avenue Extension to establish "street walls" consistent with the typical pattern of Boston neighborhoods.
- Vehicular right-of way extending Columbus Avenue to Ruggles Street Station concourse, drop-off circle, garage access and Tremont Street.
- Additional rights-of-way to connect Columbus Avenue Extension with Tremont Street.
- Extension of Ruggles Station concourse to Tremont Street where it is to be symbolically represented.
- Parking spaces for 500 to 1200 cars.
- Public open space.
- Accommodation of Southwest Corridor open space system in the site design, including an easement for recreational activities through the site parallel to Tremont Street.

Table I E-2 Summary Comparison of Alternatives-Ruggles Center

Parameter	Alternative 2 19-Story	Alternative 3 14-Story	Alternative 4 9-Story	Alternative 5 Developer's Proposal	Master Plan Design
Site Area Sq. Footage	245,000	245,000	245,000	245,000	222,296
Developed Gross Sq. Footage	1,035,200	880,200	688,600	989,900	968,175
Max. Bldg. Height (ft.)	225	180	125	168	168
Max. Floors/Bldg.	19	14	9	15	15
Land Use (Sq. Footage)					
Office	771,700	616,700	430,000	617,650	470,470
Retail	51,180	51,180	43,900	25,275	34,400
Lobby/Service	30,720	30,720	26,100	45,325	58,030
Cultural	90,600	90,600	90,600	0	0
Housing	91,000	91,000	98,000	0	0
Hotel/Restaurant	0	0	0	168,550	165,850
Day Care	0	0	0	13,500	13,200
Above Ground Parking	0	0	0	119,600	226,225
Above Ground Parking Spaces	0	0	0	275	640
Parking Spaces	1,200	800	500	815	335
Underground Parking Levels	3	2	2	3	3

Table I E-3 Comparison of Alternatives-Ruggles Center

Subparcel	Parameter	Alternative 2 19-Story	Alternative 3 14-Story	Alternative 4 9-Story	Alternative 5 Dev. Proposal	Master Plan Design
18A	Principal Use	Office	Office	Office	Office	Office
	Building Height	225	180	125	118	118
	Gross Sq. Footage	419,500	339,500	250,000	165,275	165,275
	Land Use (Sq. Footage)					
	Office	384,250	304,250	220,000	149,450	145,725
	Retail	21,150	21,150	18,000	5,925	9,650
	Lobby/Service	14,100	14,100	12,000	9,900	9,900
18B	Principal Use	Cultural	Cultural	Cultural	Office	Office
	Building Height	75	75	75	168	155.5
	Gross Sq. Footage	90,600	90,600	90,600	239,350	234,425
	Land Use (Sq. Footage)					
	Office	0	0	0	216,350	206,245
	Retail	0	0	0	5,775	6,375
	Lobby/Service	0	0	0	13,725	18,605
	Day Care	0	0	0	3,500	3,200
18C	Principal Use	Office	Office	Office	Hotel	Hotel
	Building Height	225	180	125	168	168
	Gross Sq. Footage	352,500	277,500	174,000	190,675	190,675
	Land Use (Sq. Footage)					
	Office	326,250	251,250	153,000	0	0
	Retail	15,750	15,750	12,600	4,175	5,200
	Lobby/Service	10,500	10,500	8,400	17,950	19,625
	Hotel/Restaurant	0	0	0	168,550	165,850
	Hotel Rooms	0	0	0	199	199
18D	Principal Use	Housing	Housing	Housing	Office	Office
	Building Height	70	70	70	124	120
	Gross Sq. Footage	91,000	91,000	98,000	140,200	140,200
	Land Use (Sq. Footage)					
	Office	0	0	0	124,650	118,500
	Retail	0	0	0	1,800	1,800
	Daycare	0	0	0	10,000	10,000
	Lobby/Service	0	0	0	3,750	9,900
	Housing Units	150	150	200	0	0
18E	Principal Use	Office	Office	Office	Garage/Office	Garage
	Building Height	50	50	50	108	82
	Gross Sq. Footage	81,600	81,600	76,000	254,400	237,600
	Land Use (Sq. Footage)					
	Office	61,200	61,200	57,000	127,200	0
	Retail	14,280	14,250	13,300	7,600	11,375
	Lobby	6,120	6,120	5,700	0	0
	Above Ground Parking	0	0	0	119,600	226,225

Comparison with Prior Alternatives

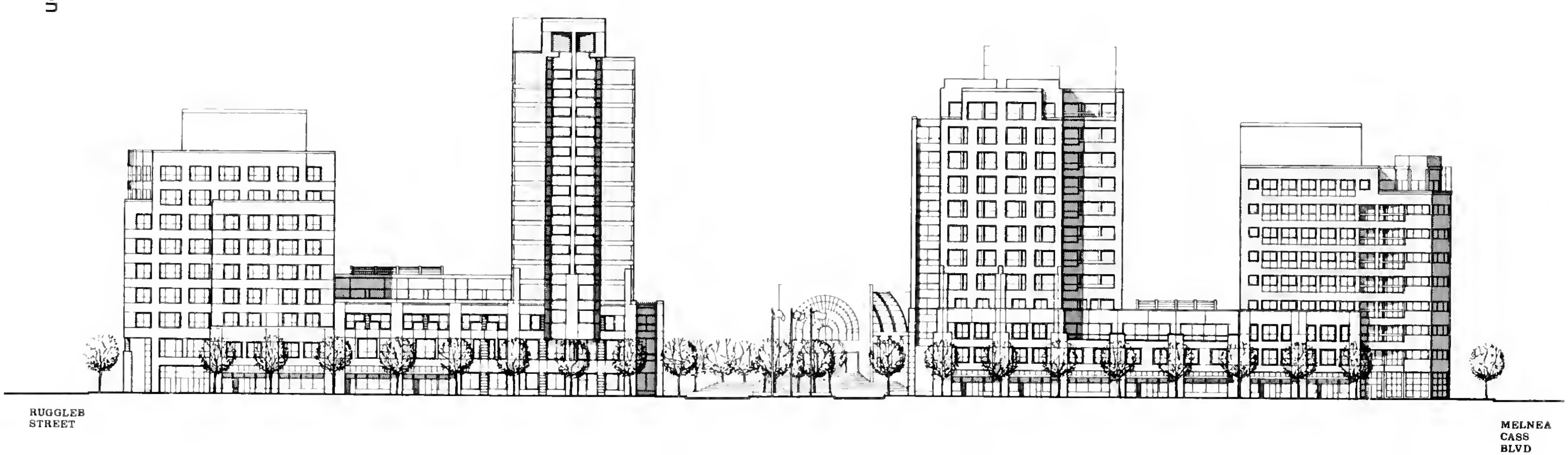
the developer's preferred alternative and the subject of this Final Environmental Impact Report. The key land uses and building parameters for the Master Plan Design are also shown in Table I E-1 to facilitate comparison with earlier alternatives.

The Master Plan Design reflects a 24 percent reduction in office space over the Developer's Alternative (from 617,650 to 470,470 sq. ft.). There is also a 36 percent increase in retail space (from 25,275 to 34,400 sq. ft.). Also significant is the use of above ground parking for 640 vehicles. Previous designs called for underground parking under all buildings except Building 5. In the Master Plan Design, only 335 cars will park underground below the hotel (Building 3) and the adjacent office building (Building 4). This compares to 815 underground parking spaces, originally scheduled for the Developer's Alternative.

Table I E-3 compares land uses and size of individual buildings for previous alternatives studied and the Master Plan Design.

Design Concept

Figure I E-2 shows a Tremont Street elevation of Ruggles Center. Medium height buildings at 9 to 15 stories (approximately 140-195 feet total building height) are proposed with lowrise elements and other massing articulations to relate to nearby structures. The primary organizing element for situating buildings on the site is a central pedestrian plaza connected to the Southwest Corridor Park. The plaza will be on axis with the entry portal at Ruggles Station and will open onto Tremont Street at the other end.



TREMONT ST. ELEVATION

Figure I E-2

RUGGLES CENTER
METROPOLITAN/COLUMBIA PLAZA VENTURE
STULL & LEE INC. ARCHITECTS AND PLANNERS

JUNE 1, 1999

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F. Regulatory Review and Approvals Required

Many federal and state permits and approvals are required to complete the Ruggles Center Project. Summarized below are the most important federal and state approvals needed.

Approvals	Agency
Federal	
Approval of Sale of Garage Site	Urban Mass Transportation Authority
State	
Acquisition of Property from the Massachusetts Bay Transportation Authority	Massachusetts Bay Transportation Authority
Conveyance of Parcel of Land from Department of Public Works	Department of Public Works
Release from Department of Public Works of Deed Restrictions	Department of Public Works
Curb Cut Permit	Department of Public Works
Alteration of Traffic Signal Street Lighting and Signage	Department of Public Works
Sewer Connection and Extension Permit	Department of Environmental Protection—Division of Water Pollution Control
Fossil Fuel Utilization Permit	Department of Environmental Protection
Compliance with Massachusetts Contingency Plan	Department of Environmental Protection
Approval to Issuance of Building Permit for Former Railroad Land	Executive Office of Transportation and Construction

G. Draft Section 61 Findings

Introduction

The FEIR details the impacts on the environment expected from the project. Inevitably, change causes such impacts, especially when development takes place on a vacant piece of land. However, this FEIR also describes the many ways in which those impacts can be minimized and accommodated. In order to assist State agencies in issuing permits, we have developed, as part of the FEIR, a consolidated summary of the major impacts and mitigation measures proposed for the project. Implementation of these and other measures will enable State agencies to make the findings required by MGL Chapter 30, Section 61.

Section 61 of the Massachusetts Environmental Policy Act (MEPA), M.G.L. c.30, § 61, requires that agencies of the Commonwealth utilize all practicable means and measures to minimize damage to the environment. The statute pertains to the issuance of State permits required for private projects. State permits for projects, such as Ruggles Center, which are subject to MEPA, may be issued only after certification by the Executive Office of Environmental Affairs (EOEA) that the required impact review process has been completed. Thereafter, State agencies may issue permits based upon a finding which describes the project's environmental impacts and determines that all feasible measures have been taken to avoid or minimize impacts.

In the Certificate, dated May 22, 1989, the Secretary of Environmental Affairs directed project proponents to prepare Draft Section 61 Findings and include them in the FEIR for Ruggles Center. The following sections describe the environmental impacts associated with development of Ruggles Center and identify feasible mitigation measures that will reduce unwanted impacts. Each area of environmental concern is presented separately.

Transportation

Overview

Ruggles Center benefits significantly from its location adjacent to the new Orange Line with its extensive feeder bus system and commuter rail access, allowing for a high proportion of transit use. This means that access by automobile should be less than 50% with a corresponding lower parking demand.

The auto demand is served by several well-defined arterial roadways with direct routings to downtown and regional highways. Melnea Cass Boulevard leads directly to the Southeast Expressway and Massachusetts Turnpike, while Tremont Street to the south, coupled with Ruggles Street, Huntington Avenue, Columbus Avenue, and

New Dudley Street, serves traffic destined to the south and west. Minor demand to and from the northwest is accommodated by Columbus Avenue and Tremont Street to the north.

Given planned development in the area, some roadway improvements will be necessary even without the project, a number of which are already being pursued by public agencies. Project related traffic improvements are being pursued cooperatively with these public agencies and the project proponent.

Traffic Impacts

Managing traffic impacts is an important aspect of the development of Ruggles Center. Analysis of traffic impacts included an evaluation of existing conditions and estimate of future (1996) conditions with and without the project.

Traffic operations were analyzed in terms of levels of service (LOS) at 10 key intersections in the study area during the weekday morning and evening peak hours, and for the Saturday peak hour. LOS for signalized intersections is defined in terms of delay and ranked from A to F, where LOS A represents a situation of little or no delay and LOS F represents long delays under breakdown conditions. From a traffic operations standpoint, LOS D is considered acceptable in urban areas, as the peak hour demands are still less than capacity, and delays are tolerable.

Table I G-1 indicates intersections which operate with unacceptable delay, and thereby poor LOS, for Existing, No Build, and Build conditions. The table also compares these conditions without implementation of the proposed No Build roadway improvements and Build mitigation measures to the LOS which results from implementing recommended improvements and mitigation measures at each level of analysis. Existing, No Build, and Ruggles Center conditions are discussed specifically below.

Existing Conditions

Traffic operations at study area intersections are generally at acceptable LOS during the morning and Saturday peak hour periods. During the evening peak hour period, three intersections operate at unacceptable levels of service:

- Tremont Street/Melnea Cass Boulevard (LOS F),
- Huntington Avenue/Ruggles Street (LOS E); and
- Parker Street/Ruggles Street (LOS F).

Table I G-1

Intersection Levels of Service for Existing, No Build, and Build Conditions with and without Implementation of Roadway Improvements

Situation/Problem Intersection	Peak Hour	Level of Service: Without Improvements	Level of Service: With Improvements[1]
EXISTING CONDITIONS			
Tremont/Melnea Cass	PM	F	na
Huntington/Ruggles	PM	E	na
Parker/Ruggles	PM	F	na
NO-BUILD (1996) CONDITIONS			
Tremont/Melnea Cass	AM	E	C
	PM	F	D
Huntington/Ruggles	PM	F	C
Parker/Ruggles	AM	F	C
	PM	F	C
BUILD (1996) CONDITIONS[2]			
Tremont/Ruggles/Whittier	PM	E	D
Tremont/Melnea Cass[3]	AM	E	C
	PM	E	D

Notes:
1 Refer to Table I G-2 for list of No Build improvements and Build mitigation.
2 Assumes No Build improvements have been implemented.
3 Recommended Access Option 2 - with Tremont right in/out only.

No Build Conditions

Between 1988 and 1996, estimated local and through traffic in the area will increase by approximately 14 percent without the Ruggles Center development. This amount of growth is significant and overshadows the impact of Ruggles Center itself. By 1996, there will be unacceptable levels of delay in the morning and evening peak hours at the Tremont Street/Melnea Cass Boulevard intersection. The Huntington Avenue/Ruggles Street intersection's current evening peak hour delay problems will be worsened, and the traffic operations at the Parker Street/Ruggles Street intersection will decline to unacceptable levels during the morning peak period.

No Build Mitigation

To mitigate these No Build impacts, Table I G-2 identifies several roadway improvements that will reduce delay and increase safety. The types of improvements include:

- redesignation of existing travel lanes, with corresponding revisions to pavement marking delineation;
- design changes at intersections for better traffic channelization;
- construction of additional travel lanes along intersection approaches; and,
- signal rephasing and retiming.

Discussions are underway with the City of Boston Transportation Department and the MBTA to implement the various improvements shown in the table. One major project, the widening of Ruggles Street between Tremont Street and Huntington Avenue, is currently in design under an MBTA contract, including the Ruggles/Parker and Ruggles/Huntington intersections. Tremont/Melnea Cass improvements are being negotiated with the Boston Traffic Department.

With these improvements in place, levels of service will improve to D or better for the three intersections:

- Tremont Street/Melnea Cass Boulevard will improve to LOS C in the AM peak and LOS D in the PM peak;
- Huntington Avenue/Ruggles Street will improve to LOS C in the PM peak; and

Table I G-2
Study Area Roadway Improvements

Situation/Location	Responsibility	Description of Improvements
NO BUILD IMPROVEMENTS -		
Ruggles Street Corridor:	MBTA and City of Boston	Ruggles Street improvements from Tremont Street to Huntington Avenue. Widening and improving Ruggles Street to two lanes of travel in each direction and intersection improvements to facilitate bus turning movements.
- *Tremont/Ruggles/Whittier*	MBTA and City of Boston	Turning radius improvements at the Ruggles Street leg of the intersection, including designated right turn lanes and traffic islands.
- *Ruggles/Ruggles Station Busway*	MBTA and City of Boston	Busway widening and turning radius improvements.
- *Parker/Ruggles*	MBTA and City of Boston	Ruggles Street widening will provide for two approach lanes in each direction along the Ruggles Street approaches.
- *Huntington/Ruggles*	MBTA and City of Boston	Ruggles Street widening will provide for the following lane use designations: ◦ one left turn lane and one multi-purpose lane along the westbound Ruggles Street approach; ◦ two multi-purpose lanes along the Louis Prang approach coupled with a peak hour left turn prohibition; ◦ two through lanes and designated right turn lane along northbound Huntington Avenue approach; and ◦ improved signage and enforcement of existing left turn prohibitions along both Huntington Avenue approaches.
Melnea Cass/Washington	City of Boston	Improve signage and enforce peak hour eastbound left turn prohibition.

Table I G- 2 Cont'd
Study Area Roadway Improvements

Situation/Location	Responsibility	Description of Improvements
NO BUILD IMPROVEMENTS CONT'D -		
Tremont/Melnea Cass	City of Boston	Widen the northbound Tremont Street approach from three to four lanes consisting of: one left turn lane, two through lanes and one right turn lane.
		Increase southbound Tremont Street approach from two to three lanes through pavement restriping including: one left turn lane, two multi- purpose lanes.
		Widen the eastbound Melnea Cass approach from two to three lanes providing for: one through/left lane, one through/right lane and one right turn lane.
BUILD MITIGATION -		
Tremont/Ruggles/Whittier	City of Boston	In addition to implementation of the No Build improvements, the redesignation, with appropriate pavement markings, of existing travel lanes along the northbound Tremont Street approach to provide for: two left turn lanes and two through travel lanes.
Tremont/Melnea Cass	City of Boston	In addition to implementation of the No Build improvements, widen the northbound Tremont Street approach for an additional left turn lane.
LONG RANGE ROADWAY IMPROVEMENTS -		
Tremont Street Corridor	City of Boston	Tremont Street improvements from Ruggles to New Dudley Street as part of the access requirements of the Parcel P-3 (Afro-American Center) and Parcel 22 developments.
Melnea Cass/Washington	MBTA and City of Boston	As part of the Washington Street replacement service, including the provision of left turn storage lanes along both Melnea Cass Boulevard approaches.

- Parker Street/Ruggles Street will improve to LOS C in the AM and PM peak.

Ruggles Center Impacts

Traffic impacts were analyzed for the Master Plan Design, the intended development scenario. Due to its smaller scale (39% less office space), the Master Plan Design's traffic impacts are already significantly reduced from the 19-Story Office Building alternative analyzed as the "worst case" in the DEIR. This reduction of scale is a major mitigating measure in and of itself.

The recommended vehicular access to the site allows traffic to enter and exit the site from one entrance at the Melnea Cass Boulevard/ Columbus Avenue intersection, and another on Tremont Street, mid-way between Melnea Cass Boulevard and Ruggles Street. The drive-way at Tremont Street will be restricted to right turns in and out of the site.

Once the No Build roadway improvements are implemented, traffic associated with Ruggles Center will lengthen average delay per vehicle by only a few seconds compared to the No Build condition. Most intersections in the study area will operate within acceptable traffic operating conditions, with the exceptions of:

- Tremont Street/Ruggles Street/Whittier Street (LOS E in the PM peak); and

- Tremont Street/Melnea Cass Boulevard (LOS E in the AM and PM peaks).

Mitigating measures to accommodate added Ruggles Center traffic are also identified in Table I G-2. In addition to the implementation of the improvements identified for the No Build conditions, the recommended Build mitigation measures will improve traffic operating conditions to acceptable levels at both intersections, as follows:

- Tremont Street/Ruggles Street/Whittier Street will improve to LOS D in the PM peak; and

- Tremont Street/Melnea Cass Boulevard will improve to LOS C in the AM peak and to LOS D in the PM peak.

Parking Supply/ Demand Impacts

Existing parking supply in the immediate site area consists primarily of Northeastern University parking. Northeastern University parking consists of a garage on Columbus Avenue and temporary parking lots, most of which are scheduled to be replaced by structured parking as vacant parcels are redeveloped. Parking in the site area is not a problem today, since much of the land is vacant.

No Build Parking Impacts

A comparison of parking supply and demand associated with background development yields a deficit of 447 spaces compared to an estimated additional peak demand of 2,286 spaces within the study area for 1996.

Ruggles Center Parking Impacts

The proposed parking supply for the Master Plan Design is 975 spaces. Demand was calculated by two methods, one based on the trip generation which yielded a total deficit of 250 spaces, and one in accordance with Urban Land Institute (ULI) procedures based on standard ratios of parking spaces per gross square feet of floor space for each land use. This method yielded an overall surplus of 34 spaces. One reason for the difference is that ULI method yields a much lower forecast of office employee spaces (about 300 less).

If the No Build and Ruggles Center parking estimates are combined, then the overall study area deficit could range from 697 to 413 spaces, compared to an additional demand averaging about 3,300 spaces.

The possible shortfall in office employee spaces is seen as an appropriate influence to increase transit and car pool use. The transportation management policy to be supervised by the developer and project tenants will be to reduce automobile demand through transit and car pool promotion. It is felt that the parking equilibrium which will be reached will compare well with the lesser demand predicted through the ULI method.

Public Transportation System Impacts

The impacts of Ruggles Center on the public transportation system will be focused on four system components which must serve up to almost 500 person trips in both weekday peak hours. These system components are listed below with an indication of weekday peak hourly trips:

- Orange Line north and south (270± persons);

- Green Line (E branch) north and south (60± persons);
- Bus routes serving the site (150± persons); and
- Commuter Rail (20± persons)

In all cases, the additional ridership can be easily handled by the MBTA system.

Pedestrian Impacts

Ruggles Center has been designed to strengthen pedestrian activity in the area, and to reinforce and extend development along Columbus Avenue and Tremont Street, both major radial boulevards. There are four major pedestrian access and circulation needs which have been addressed — access to Ruggles Station, Southwest Corridor pedestrian and bicycle connections, Ruggles Center access, and site area street pedestrian links. The pedestrian volumes generated can be adequately served on the sidewalks, paths, and crosswalks provided. Bicycle safety will be addressed through signage and other design measures.

Air Quality

In the vicinity of the proposed Ruggles Center, automobiles, trucks and buses are the principal sources of air pollution. The emission of pollutants by stationary sources (industrial and commercial operations) is very small. Consequently, measurement of carbon monoxide (CO) concentration, which is the best single indicator of motor vehicle pollutant emissions, is a good proxy for levels of local air pollution. Currently, ambient levels of CO in the area measure within State and Federal standards.

DEIR Analysis

For the DEIR, extensive analysis was performed to determine the impact of proposed development on the local air quality. At intersections where traffic flow is heavy and people are likely to congregate, current CO levels were estimated, using two computer simulation models — MOBILE3 and CALINE3. These programs were developed by the U.S. EPA and accepted by the Massachusetts DEP. Motor vehicle CO emissions were also predicted for the future with and without Ruggles Center.

The air quality analysis in the DEIR tested the largest build option (Alternative 2) and concluded that for the most intensive

development proposed, CO emissions at 10 sensitive receptors for 1-hour and 8-hour periods were below the Massachusetts and National Ambient Air Quality Standards (NAAQS).

Master Plan Impacts

The Master Plan Design represents a substantial reduction in scale from Alternative 2, studied in the DEIR. Office space, the largest generator of additional traffic, is reduced by 39 percent. Thus, air quality impacts in the study area will be less than those determined in the DEIR. The FEIR concludes, therefore, that the major improvement to anticipated air quality will result from the reduced scale of the development.

MEPA requires that air quality analyses be conducted at intersections where traffic operations are at LOS D or worse <u>and</u> project generated traffic contributes more than 10 percent to total intersection volumes. For the FEIR, two additional intersections were added to the traffic impact analysis along Melnea Cass Boulevard at Washington Street and at Massachusetts Avenue.

The analysis of traffic impacts associated with the Master Plan Design indicate that the Melnea Cass/Washington intersection will operate at LOS C or better during all peak hour periods, assuming enforcement of the existing peak hour left turn prohibition along the eastbound Melnea Cass Boulevard approach. The intersection of Melnea Cass/Massachusetts/Southamption/Expressway Ramps is expected to operate at LOS D during the morning and evening peak hour periods. However, traffic generated at this location by the project is expected to contribute only 4.6 percent and 5 percent to total traffic at the intersection during the morning and evening peak hour periods, respectively. Air quality analysis at these two intersections are therefore not required in accordance with MEPA guidelines.

The air quality analysis presented in the DEIR sufficiently addresses the air quality impacts of the Master Plan Design alternatives. As in the DEIR, the traffic analysis in the FEIR assumes that all roadway improvements indicated as necessary to provide acceptable traffic operations are implemented. These roadway improvements are sufficient to mitigate any potential air quality problems due to No Build traffic congestion and vehicle trips related to the Master Plan Design.

Noise

The existing noise adjacent to and on the Ruggles Center site is relatively high. Numerous sources, typical of an urban environment, are major contributors and include noise from traffic (especially buses), equipment, aircraft flyovers and construction.

DEIR Analysis

In the DEIR, an extensive analysis was performed to estimate current noise levels generated by peak traffic flows. The analysis used a Federal Highway Administration model (FHWA RD-77-108, 1978) to predict noise levels with and without development of Ruggles Center.

Predictions based on traffic projections along Ruggles Street for the No-Build Alternative indicated that there would be no increase in noise levels above 1988 levels. Along Tremont Street, the analysis indicated that noise levels would increase by 1 decibel as compared with 1988 conditions. This increase would be imperceptible to the human ear.

In order to assess the noise impact of the build alternatives, traffic projections for Alternative 2 and Alternative 5 were used as input to the FHWA noise prediction model. Alternative 2 was studied because it was the alternative with the largest building program and related traffic generation. Alternative 5 was studied as the Developer's Proposal.

The results of the noise prediction analysis indicated that neither Alternatives 2 nor 5 would alter noise levels along either Ruggles Street or Tremont Street.

Master Plan Impacts

The reduction of project size under the Master Plan Design results in less traffic and consequently, less associated noise than was predicted for either alternative in the DEIR. At the two intersections not studied in the DEIR - Melnea Cass Boulevard at Washington Street and at Massachusetts Avenue - contribution of project traffic was less than 10 percent and thus no additional analysis of noise impacts was needed.

Mitigation Measures

The proposed development benefits from the fact that certain noise mitigation measures, such as depressed transit tracks, are already in place in the area. Several other measures anticipated for the project will have a positive influence on noise. Traffic mitigation, discussed in the Transportation Section, are planned. The project itself

is reduced in size, a reduction that will produce a decrease in the traffic contributed to the area by the project. Because there is no residential housing planned, a sensitive land use receptor has been removed from the site.

In addition, several design measures have been adopted which will reduce noise. Wind remedies, including landscape and architectural shields, will be employed to reduce wind and noise impacts on the playground and open space areas. Through the use of such site planning techniques and treatments, the overall impact of traffic-related noise on Ruggles Center and adjacent properties will be further reduced.

Utilities

Introduction

The Master Plan Design substantially reconfigures the land use allocations at Ruggles Center. When compared with the initial Developer's Alternative examined in the DEIR, office space is reduced almost 24 percent and retail space is increased 36 percent. These changes, particularly the reduction in office space, noticeably alter the demand for utilities. Thus, a new demand analysis for the project was performed and is detailed in Chapter II, Section B.

Table I G-3 summarizes the demand for utilities generated by the project.

Adequacy of Supply Networks

The utility demand analysis shows that local area supply networks are adequate to handle Ruggles Center demand for water, sewer and power provided that conservation practices are observed. The existing BWSC water system within the project area can meet the supply demands of the Master Plan Design. Extension of a water main in the Columbus Avenue Extension may be necessary to provide some connections. The sewer and storm drain systems servicing the project site are adequate. The Boston Edison Company has plans to upgrade the electric distribution system in the area to meet future demands. The electrical demand for the project can be supplied by Boston Edison Company's existing 13.8 kV distribution system and converted by a transformer in an internal vault in the building. Upgrading of the system, however, will be necessary to meet increasing demands as the Ruggles Street area around and adjacent to the project site is renovated/redeveloped. The gas system is considered adequate to meet the estimated project requirements. The Boston Gas Company, however, reserves the right to review each connection application individually and will generally make system adjustments as necessary.

Table I G-3 Summary of Ruggles Center Demand for Utilities

Utility	Unit	Project Demand
Water		
Avg. Daily Domestic	gpd	113,745
Air Conditioning Make-Up	gpd	102,490
Total	gpd	216,235
Peak Demand	gpd	568,845
Sanitary Sewer	gpd	98,640
Storm Flow	cfs	22.78
Peak Electric	Mw	6.66
Gas	cfh	26,045

Mitigation Measures

The project proponent recognizes that power and water supplies in the Northeast are finite resources. During the last decade, a strong economy has brought new development to the Boston area and with this expansion, demand for utilities has strained distribution networks and supplies. The mitigation measures summarized below address how the project proponent will minimize new demand for utilities and coordinate with State agencies during construction.

Conservation

Energy Efficient Appliances

Ruggles Center will use energy efficient appliances and fixtures that meet or exceed the requirements set by the Boston Redevelopment Authority (BRA) and the Massachusetts Building Code. These will limit the increased demand on energy supplies and distribution networks.

Strict Observance of Water Conservation

The amount of additional water required to satisfy the proposed development will be kept to the minimum amount possible. To assure this, Ruggles Center will comply strictly with the Commonwealth of Massachusetts Plumbing Code with respect to low flow plumbing fixtures. In addition, the project design will incorporate the latest possible facilities to ensure efficient use of water in areas such as: interior and exterior irrigation devices, use of fountains, water coolers and water flow devices.

Sanitary Flows

Reduction of Sewer Overflows

The MWRA is presently preparing a study of the combined sewer overflow (CSO) system that will make recommendations on methods for eliminating or minimizing the impact of CSO's on the water quality of receiving waters. A draft version of this report is due to be made available in January, 1990 with the final report filed in mid-1990. Until such time as the recommendations of that report are known, both the MWRA and BWSC have agreed that the best available method of reducing the CSO impact on receiving waters is to minimize the volume of sanitary flow exposed to overflow conditions by separation of dry and wet weather flows and by the use of water conservation measures to reduce the volume of sanitary flows generated.

The sewer system servicing the proposed site area was reconstructed, to a large extent, during the Southwest Corridor Project construction. The local systems to which the project flows will be discharged have been separated. Ruggles Center will moderate sewer flows by implementing and using water conserving facilities and practices required by the Massachusetts Plumbing Code and other design elements.

The developer will be preparing a water and sewer site plan during the design phase which will detail the physical relationship of project elements to existing water and sewer facilities, the project service connections, projected flows at each location and other pertinent design information. These plans will be submitted to both the MWRA and BWSC for approval prior to the issuance of service connection permits by DEP.

Access to Water Mains and Drainage Tunnels

Boston Main Drainage Tunnel

The southwest corner of the site (at the corner of Ruggles and Tremont Streets) is traversed by a 50 foot wide easement. This easement contains the 10 foot wide Boston Main Drainage Tunnel, currently under the jurisdiction of the MWRA. The tunnel, which is located within bedrock approximately 300 feet underground, carries effluent from the Ward Street Headworks to the Deer Island Treatment Plant. The proposed building has been designed to cover this easement at ground level. The developer will coordinate closely with the MWRA on this and all building design which may involve impact on water mains and drainage tunnels.

Relocation/Access to Sanitary Sewers, Storm Drains, and Water Mains

Where construction over, or adjacent to, sewers, drains or water mains is planned, relocation of or access to these lines for repair and maintenance will be provided by the developer in accordance with the requirements of and subject to the approval of the appropriate agency, BWSC or MWRA.

Hazardous Substances

Because Parcel 18 was formerly the site of numerous businesses identified in preliminary studies as potential sources of contamination, investigations of the site have continued. Below is a summary of the results of site investigations performed since the DEIR and mitigation measures currently proposed.

Site Investigations

Phase I and II Oil and Hazardous Material Site Evaluations have been conducted following the guidance of the Massachusetts Contingency Plan (MCP), the procedures which govern containment and removal of oil or hazardous materials. Chemical test data from the Phase II evaluation indicated that petroleum contamination is present in certain areas in the soils and groundwater beneath the site.

Some site soils have been contaminated primarily by petroleum hydrocarbons including gasoline, kerosene, fuel oil and lubricating oils as well as low levels of pesticides and metals distributed randomly throughout the site soil. The contamination is likely to have resulted

from petroleum storage on site, fill materials brought on site; or from former commercial and light manufacturing operations. Much of what was found at the site can be characterized as urban fill typical of downtown Boston.

In most instances, groundwater at the site was found to contain low levels of petroleum hydrocarbons, associated volatile organic compounds, metal and pesticides. Groundwater, in most instances, however, meets drinking water guidelines or standards available for selected compounds.

Investigations located three underground storage tanks. A fourth storage tank is suspected. Phase-separated petroleum product was found near the suspected tank location as well as in a test pit where kerosene was also identified.

Risk Assessment Results

A risk assessment was conducted by Meta Systems and Menzie and Associates, Inc. in May, 1989 to evaluate the risk of harm to human health, safety, public welfare and the environment from contamination at the site. The assessment evaluated several different target receptors using various exposure points and migration pathways. All of the scenarios involved at grade construction schemes.

The risk assessment found that risks to human health or the environment associated with the site in its present condition, during and after construction do not exceed DEP's benchmarks for acceptable risks.

The report did recommend that dust control measures be implemented during construction and that risks to children be minimized by capping the soil or removing soil and filling play areas with clean material.

Mitigation Measures

The MBTA, as the principal land owner, has initiated the recent site investigations in compliance with the Massachusetts Contingency Plan and will be responsible for development of Remedial Response Alternatives and the Implementation Plan. Results of Phase I and II investigations suggested that several important mitigation measures be implemented. These are summarized below. Entities responsible for mitigation are indicated in the parentheses.

a. To minimize soil excavation, the Master Plan Design will incorporate at grade construction techniques. For Build-

ings 3 and 4, where underground parking is planned, the proponent will remove contaminated soil where necessary in compliance with DEP regulations.

[Ruggles Center Proponent]

b. Underground tanks will be located and removed. Petroleum contaminated soil surrounding the tanks will be removed and disposed of in accordance with Federal, State and local requirements.

[MBTA]

c. Phase-separated petroleum products identified at the site will be further evaluated and mitigated in accordance with the findings of the evaluation.

[MBTA/Ruggles Center Proponent]

d. Risks to children will be minimized by capping or removing soil from play areas and filling with clean material.

[Ruggles Center Proponent]

e. Dust control measures will be adopted during construction activities to reduce levels of risk associated with concentrated metals in the soil.

[Ruggles Center Proponent]

f. Construction supervisors and workers will be briefed on known site conditions and the potential for discovery of buried tanks, utility piping and wiring, and other objects which may be unearthed during excavation of the site.

[Ruggles Center Proponent]

g. A management plan will set procedures to limit and avoid spillage and emissions, take corrective action should they occur and carry out remediation in accordance with DEP regulations.

[MBTA/Ruggles Center Proponent]

h. Construction activity will be monitored to identify heavily contaminated soils which may require special handling.

[Ruggles Center Proponent]

i. Construction supervisors and workers will be advised to use caution in handling fuels and oils on the site to avoid spillage and contamination of the soil. No smoking signs and other precautionary notices will be prominently posted in accordance with the fuel storage and use plan.

[Ruggles Center Proponent]

j. On-site re-use of excavated soil with low levels of contamination will be utilized, where feasible.

[Ruggles Center Proponent]

k. Once construction is completed, chemicals and other substances used by tenants will be controlled by the establishment of prevention plans and procedures to deal with unplanned releases.

[Ruggles Center Proponent]

l. A single source document, the Implementation Plan, will be prepared to guide construction activities. Included in the Implementation Plan are:

- list of contacts;
- site map;
- final design, consisting of complete plans and specifications which shall include: schedule for implementation; complete plans and specifications; health and safety plan; environmental monitoring plan; contingency plan; and security plan;
- construction plan, including all of the above, in final form;
- operations and maintenance plan, including quality assurance and quality control.

The Implementation Plan, once in place, should provide adequate prevention and control measures for the site so that there will be no long-term adverse impacts from the proposed development.

[MBTA/Ruggles Center Proponent

Visual Quality Massing Shadows

The proposed Ruggles Center will be the first commercial development completed along the Southwest Corridor. As such, its impact on the neighborhood is significant and will set the tone for other developments which follow. A full discussion of visual quality, massing and shadows appears in Chapter II, Section C.

The design of Ruggles Center has undergone many iterations to better integrate the buildings with the neighborhood and reduce shadow impacts. The Master Plan Design embodies several changes which will have a direct and positive impact on visual quality, massing and shadows. Below is a summary of changes and key elements of the design:

a. Reduction in overall developed square footage and building mass;

b. A 1 1/2 story reduction in the lowrise portion of Building 3 near the Ruggles Station Park, resulting in reduced morning shadows on the park and playground area;

c. Setback from Ruggles Street of upper two floors of the Building 4 facade, especially at the corners, resulting in reduced morning shadows on the Southwest Corridor Park and Ruggles Street;

d. Provision of space between pairs of proposed buildings to maintain a corridor of sunlight during times of the day and year when building shadows do not overlap;

e. Achievement of needed scaling and transitions to other buildings in the area through the use of medium height buildings, 9 to 15 stories, with lowrise elements and other massing articulations;

f. Creation of a street wall in a "traditional Boston" manner by situating buildings next to the property line;

g. Location of prominent building components such as rounded corners, setbacks and other massing articulations to take advantage of key view corridors and corner vantage points;

h. Placement of an octagonal massing element at the highly visible corner of Melnea Cass Boulevard and Tremont Street; and,

i. Creation of the linear plaza opening onto Tremont Street to allow for direct visual access to the station entry. The central pedestrian plaza, extensively landscaped and connected to the Southwest Corridor Park, will serve as the center of pedestrian activity and provide multiple points of entry into the complex.

To determine the net new shadows generated by the proposed Master Plan Design, the shadow impact of all buildings in Ruggles Center was compared to shadows which are currently cast by existing buildings in the area of the project site. This comparison was made for shadows cast at 9 AM, 12 Noon and 3 PM on the following dates: March 21, June 21, September 21 and December 21. These dates represent the winter solstice when the sun is the lowest and the shadows greatest; the spring and autumn equinoxes and the summer solstice when the sun is highest and the shadows minimized. These dates bracket the extremes of the sun's movement.

As detailed in Chapter II, Section C and in the shadow diagrams found there, the proposed Master Plan massing will introduce a net increase in shadows as is inevitable when new buildings are placed in the middle of a previously open area. For the key location, Ruggles Street Station, new shadows will occur primarily in the morning at the South entrance and bus platforms. The central Plaza will be in full sun by late morning in winter and in spring, and by noon in summer and fall, when lunchtime use of the space is expected to be most frequent. Shadow impact on the Southwest Corridor Park is minimal and limited to a very small portion at its eastern end. Except during summer months, considerable new morning shadow will be cast on the Ruggles Station Park. Afternoon shadows occur primarily in the winter and are

noticeably reduced during the spring and fall. It should be noted that, by providing a space between the pairs of proposed buildings, a corridor of sunlight is maintained during those times of the day and year when building shadows do not overlap.

Wind

For the FEIR, a special quantitative wind speed analysis was conducted to accurately define the existing wind conditions at the Ruggles Center site and to quantify the impact of the Master Plan Design. The full wind analysis is presented in Chapter II, Section D.

The objectives of the analysis were to:

- quantitatively assess the impact that the Ruggles Center would have on the existing pedestrian level wind conditions;
- compare the predicted wind conditions with standards outlined by the Boston Redevelopment Authority (BRA); and
- develop mitigative measures for identified problem areas, if necessary.

To accomplish these objectives, a 1:400 scale model of the existing site and proposed developments and surroundings was tested in a boundary layer wind tunnel. In areas predicted to have wind problems, remedial measures were investigated and discussed. A final series of wind tunnel tests were conducted to confirm the effectiveness of the proposed mitigative measures. These involved an initial test to assess the remedial solutions and a second test to refine, optimize and quantify these solutions.

The BRA has established two standards for assessing the relative wind comfort of pedestrians. First, the BRA wind design guidance criterion states that an effective gust velocity (mean hourly wind speed +1.5 times the root-mean-square wind speed) exceeded 1% of the time should be less than or equal to 31 mph. The second set of criteria used by the BRA to determine the acceptability of specific locations is best known as Melbourne's criteria. These internationally accepted criteria are used to determine the relative level of pedestrian wind comfort based on activities such as walking, standing or sitting.

Under existing conditions, several of the locations tested exceed a mean wind velocity of 19 mph (one percent occurrence) during various seasons throughout the year. This is considered uncomfortable for walking. With the proposed development and remedial devices in place, the number of locations exceeding the mean wind speed of 19 mph is greatly reduced. A similar trend is noted when analyzing the effective gust speed criterion of 31 mph (exceeded one percent of the time). Under existing conditions, fourteen of the sixty locations tested exceed the 31 mph criterion during the winter season. With the proposed development and remedial devices in place, this number is reduced to 5.

The need for remedial measures is noted as there are a number of locations subject to increased wind activity when the proposed development is in place. Prior to the placement of remedial devices, several locations are subject to mean wind speeds greater than 27 mph (exceeded one percent of the time) during the winter season. The same holds true for the effective gust criterion, as several locations are subject to gust speeds greater than 31 mph (exceeded one percent of the time) with the proposed development in place. This is observed at the corner of Melnea Cass Boulevard and the Columbus Avenue Extension as well as in the Plaza area between the hotel and office tower.

The majority of increased wind activity results from the impact of the proposed development on winds from the prevailing northwest quadrant. These winds are: intercepted and downwashed to grade by the office and hotel towers; and, accelerated through the passageways, created by the development, along the Plaza and the Columbus Avenue Extension. The recommended remedial measures greatly improve the wind conditions creating an acceptable wind climate for the intended pedestrian use.

In summary, the Ruggles Center development will have a positive effect on the existing wind environment, provided a selection of the following remedial devices, identified below, are incorporated into the development scheme.

a. The Columbus Avenue Extension/Melnea Cass Boulevard corner of the nine story office tower - canopy.

b. The lower roof section between the nine story and twelve story office tower - parapet wall.

c. The MBTA driveway side of the parking garage/commercial development - localized vegetation/landscaping.

d. The Plaza side of the twelve story office tower - canopy and vegetation/landscaping.

e. The Plaza Island - vegetation/landscaping.

f. The Southwest Corridor Park - vegetation/landscaping.

g. The Ruggles Street side of the nine story office tower - canopy and vegetation/landscaping.

h. MBTA station entrance - vegetation/landscaping.

i. The Play Area - vegetation/landscaping.

j. The Columbus Avenue Extension side of the parking structure/commercial development - localized vegetation/landscaping.

Final decisions about implementation of proposed remedial measures will be made by the Boston Redevelopment Authority and the Ruggles Center proponent.

Historic and Archaeological Resources

Historic Resources

The Ruggles Center site is currently vacant and has no historic resources which would be physically altered by the proposed development. However, three off-site structures have been identified by the Boston Landmarks Commission (BLC) as meriting consideration for purposes of this impact assessment: the Roxbury Standpipe, the St. Francis de Sales Church, and the Whittier Street Health Center.

The closest historic structures, Saint Francis de Sales Church and Whittier Street Health Center, are separated from the Ruggles Center sites by major roadways and over two hundred feet of distance. No alteration to the properties or to their immediate surroundings will be caused by the development, nor does the project propose any activities associated with the maintenance or legal transfer of these properties.

The proposed development actually enhances visual accessibility of historic resources. Ruggles Center will provide a new vantage

point from which to see the Saint Francis de Sales Church and much of Roxbury. The Master Plan Design integrates well with the neighborhood. By stepping down the scale of the project and by providing linkage of common areas and open space, the design improves the context for the area's historic buildings.

Archaeological Resources

No new archaeological surveys were performed for the FEIR. As part of the MBTA Southwest Corridor Project, excavations of two areas on the site uncovered no prehistoric artifacts in situ which could be considered valuable to the further understanding of prehistoric activity in the area. These findings were reported in three documents produced by the Afro American Museum: Archaeological Reconnaissance Survey, published in 1979; a Report on the Phase II Archaeological Subsurface Testing of the Southwest Corridor Project Area, prepared in 1979; and the "Stone Jail" site report prepared in 1986.

Based on the findings of the Museum of Afro American History reports, it is unlikely that significant archaeological resources, either historic or prehistoric, continue to exist in the site. Therefore, no adverse impacts are anticipated to be caused by the proposed development.

Mitigation Measures

The proposed project has provided an improved context and 'viewing platform' for the community's historic buildings. It is far enough removed from the area's historic resources that they do not require active protection from the development. Nor does there appear to be any archaeological resources needing active protection. However, should any be uncovered during site excavation, the project proponent will have in place a contingency plan to protect and assess archaeological findings.

Open Space

Certain important open space considerations underlie the design of Ruggles Center and are reflected in the Master Plan Design.

a. Continuity with the Southwest Corridor Park (SWCP) is maintained.

b. The MBTA Parkland is well integrated with landscape elements in the Ruggles Center complex.

c. Safe pedestrian access to Ruggles Street Station and the

surrounding community is established.

d. Clearly marked bikeways enable cyclists to safely cross Ruggles Center and continue on along the SWCP.

f. Play areas for on-site day care facilities are secure and shielded from wind, noise and traffic.

g. Landscape elements are used to improve adverse localized wind or noise situations.

h. Landscape elements complement the building design and contribute to the overall coherence of the Ruggles Center development and connection to the surrounding neighborhoods.

In many respects, the Master Plan open space design is a mitigation measure itself. It responds to initial design objectives and comments offered by those who have reviewed the project. Overall, the landscape plan contributes to the coherence of the Ruggles Center development. It is the 'connecting tissue' that links the office and hotel buildings to the surrounding urban area and the Southwest Corridor Park. Special care has been given to address the needs of a diverse group of users: pedestrians, office workers, shoppers, bicyclists and commuters. The plan defines areas for sitting, safe walking and cycling and enables good access both to Ruggles Street Station, the Plaza, and the neighborhood.

Additional landscape elements will be deployed as one measure of mitigating adverse localized wind or noise situations around Ruggles Center. These elements, including various tree and shrub plantings, high planters and grade changes, will be strategically located to improve conditions for various pedestrian activities on the site. In the case of anticipated unpleasant wind conditions, extensive evergreen trees and shrubbery in high planters will serve to decrease ground level winds or divert them to other areas. In order to ameliorate potentially noisy areas to the extent possible, tree groupings will be planted to help filter and mask noise levels from nearby bus and auto traffic.

Construction

Construction of Ruggles Center will result in temporary adverse impacts in the vicinity of construction activity. However, since the DEIR, modifications to the foundation design for Ruggles Center have reduced initial concerns about noise and vibration and the amount of excavation required. A full discussion of Construction Impacts can be found in Chapter II, Section F.

Foundations

For Buildings 1 and 2, at grade construction will greatly reduce the quantity of excavated material that must be removed. This will minimize truck traffic. It also will eliminate the problem of lowering groundwater in the surrounding area and need for a dewatering system when foundations are installed. By using a grid of compacted sand elements to densify the soil under Buildings 1 and 2, the area of influence for underground vibration is significantly less than if a deep pile foundation were installed.

Under Buildings 3 and 4, the Master Plan Design calls for a below grade parking garage. The foundation system for these buildings may be a deep mat foundation or deep piles. The earth retention system would be sheet piling vibrated into place to produce a water tight cofferdam. The use of a vibratory hammer should reduce airborne noise. Once the cofferdam is in place, ground will be lowered within the contained site to allow for the installation of an underslab pressure relief system which would maintain lowered groundwater within the site. The sheeting would be left in place to minimize water infiltration.

Vibration

The primary source of construction-related subsurface vibrations will occur during installation of foundation structures. For Buildings 1 and 2, a grid of compacted sand elements, approximately 10 feet deep, will be driven to densify the soil in preparation for a structural concrete mat foundation at ground grade. The area of influence for these piles could be up to 100 feet. However, because the compaction depth is shallow, the resulting vibrations for each element will be of short duration and are not expected to adversely affect structures or utilities within the area of influence.

For Buildings 3 and 4, some vibration and ground heave or settlement might be expected. However, to mitigate these impacts, preaugering would be used for about two thirds of the pile length (80 to 100 feet). For Building 5, foundation piles will also be pre-drilled.

To minimize potential impacts of vibration on sensitive research equipment at Northeastern University, the project proponents will conduct field tests. These will be evaluated in conjunction with vibration performance requirements for research equipment located within the area of influence.

Dust, Debris, and Emissions

During the period of construction of the proposed development, some short term adverse impacts on air quality will occur. An increase in airborne particulate matter will occur in the form of fugitive dust from ground excavation, from mounds of stored earth and aggregate, from concrete construction, and from carpentry work and similar activities.

The Master Plan Design has reduced greatly the amount of site excavation required. By itself, at grade construction will limit the amount of dust emitted during excavation and foundation work.

Traffic Management

The chief transportation impacts that are of concern during the construction period are traffic impacts on streets leading to and around the site, worker parking, unloading and placement of construction materials and equipment, and site fencing and maintenance to protect pedestrians. Prior to issuing a building permit, the City of Boston will require that the developer submit a detailed Traffic Maintenance Plan. This plan is prepared in conjunction with the general contractor and is subject to approval by the Boston Transportation Department. The plan will include the routing of trucks transporting material and equipment, provision for construction of off-street worker parking, careful scheduling of deliveries, and controls governing the spilling and clean-up of materials from trucks.

Other Construction Projects

A considerable amount of both public and private investment is underway or anticipated in the general vicinity of Ruggles Center. Between now and 1996 approximately 806,000 square feet of space and 1,223 units of housing are scheduled to come on line in addition to Ruggles Center. Potential cumulative construction related impacts (traffic, noise, and air quality) may occur if schedules overlap, resulting in increased levels of traffic, noise and air quality problems.

Mitigation Measures

The following summarizes mitigation measures that the proponent of Ruggles Center will employ to reduce adverse impacts that might occur during the construction period.

Materials Movement Staging

a. The phasing of construction work will be coordinated with other proposed construction activities in the area.

b. The use of on-site locations for construction staging or 'just-in-time' delivery will minimize disturbances to the other construction activities occurring in the proximity of the project.

b. For all phases of construction, the major truck route will be the Central Artery to Melnea Cass Boulevard with a left turn at Columbus Avenue onto the Ruggles Center site. Depending on the phase of construction, the trucks will exit the site at either Tremont Street or Melnea Cass Boulevard.

c. Deliveries will be scheduled and access times controlled so that peak hour disruptions would be avoided.

d. At and near the site, truck maneuvering will be supervised by flagmen or police as necessary, and time at the site will be kept to a minimum.

e. Special safety measures will be taken to insure the safety of pedestrians and bicyclists using the Southwest Corridor Park and Ruggles Street Station.

f. Controls governing the spill and cleanup of materials from trucks will be observed.

g. Construction workers will be able to use available on-site areas for parking during the early stages of construction. The use of public transportation will also be encouraged.

Noise

a. Equipment used on the site, with the exception of pile drivers, will operate within the legal limit set by the Boston Air Pollution Control Commission.

b. The use of compacted sand elements for soil densification will significantly reduce the level of noise generally associated with deep piles. The use of a vibratory hammer will reduce airborne noise when sheet piling is

vibrated in place.

Vibration

a. When driving deep piles, the primary method to mitigate the potential impact of subsurface transmission is to incorporate the preaugering installation method. Another method of mitigation is drilled-in piles. Either of these methods may be used if the impacts of pile driving are determined to be unacceptably high.

b. To assess the area influence subject to vibration during pile installation, a ground control survey of adjacent streets and structures will be conducted prior to construction of each building.

Groundwater

a. The project proponent has selected foundation structures which minimize lowering the depth of groundwater. Ground grade construction for Buildings 1, 2 and 5 will leave the depth of groundwater virtually unchanged.

b. The use of interlocking steel sheet piling to support the sides of deep excavations is also a mitigation measure for Buildings 3 and 4 where underground garages are planned. Sheet piling will be relatively to very impermeable to groundwater seepage. This will significantly limit off-site groundwater lowering.

c. At sites with deep excavation, observation wells will be installed around the site perimeter at 100 feet spacing. Additional observation wells will be installed adjacent to wood pile-supported buildings, if any, and across the street from the excavation site. Groundwater levels will be measured in the observations wells at least weekly, more frequently if there is significant groundwater lowering (below elevation -1.0 NGVD) is found.

d. Permanent observations wells will be installed around the perimeter of permanent structures which are below groundwater level. A monitoring program will be instituted to measure groundwater levels throughout the life of the structure.

e. Groundwater withdrawn from the site during construction

will be pumped to a siltation settling tank/basin to remove fine material, prior to discharge to the existing storm drain system.

f. No permanent discharge of groundwater to sewers and storm drains is expected. Water from the pressure relief system would be recharged in surficial soil strata.

Dust, Debris, and Emissions

a. The project proponent will: 1) keep storage of excavated soil and aggregate on the site to a minimum; 2) wet earth mounds on a scheduled basis; 3) minimize disturbance of loose materials; and, 4) store materials away from pedestrian walkways.

b. Containment of other construction materials and miscellaneous trash will be controlled by proper supervision.

c. As required by the Massachusetts Contingency Plan, the MBTA and project proponent will have in place at the time of construction, a Remedial Response Plan to handle contaminated soil or other hazardous substances. (See Chapter II, Section G, Hazardous Substances.) Early removal of waste materials from the site will mitigate much of the potential problem of emissions.

d. The developer will remove waste/debris from the site frequently to assure that it does not create a waste problem.

Conclusions

In the past, economic development in Roxbury has brought short-term benefits without creating an enduring and strong economic base. Ruggles Center is designed to reverse this trend and to respond to the community's need for employment, community facilities, and housing. Residents in the immediate area can expect to benefit directly through employment opportunities, shopping convenience, and child care and recreational facilities. What makes this project different, however, is the comprehensive community benefits package associated with the development.

The creation of construction and permanent jobs will go hand-in-hand with training programs, community outreach, and affirmative

action. The developers will also participate in the construction of affordable housing and contribute substantial funds to a Community Development Fund.

Resolution of certain environmental issues are critical to the development of Ruggles Center. Traffic mitigation is key. Some roadway improvements are necessary even without the project, a number of which are already being pursued by public agencies. The presence of petroleum contamination in some areas of the site has led project proponents to incorporate in the Master Plan Design an at grade construction scheme. Following the guidance of the Massachusetts Contingency Plan, the Remedial Response Plan and Implementation Plan, once in place, should provide adequate prevention and control measures for the site so that there will be no long-term adverse impacts from the proposed development.

The design of Ruggles Center has undergone many changes to better integrate the buildings with the neighborhood and reduce shadow impacts. In fact, the proposed project has provided an improved context and 'viewing platform' for the community's historic buildings.

The Ruggles Center development will also have a positive effect on the existing wind environment, provided that certain recommended remedial devices are selected by the developer, approved by the BRA and incorporated into the final design of the project.

Finally, construction of Ruggles Center will result in temporary adverse impacts in the vicinity of construction activity. Mitigation measures planned for this project will reduce disruptions inevitable with most large construction projects.

Environmental Analysis

A. Transportation and Related Issues

Introduction

Transportation issues are central to the development of Ruggles Center. In 1972, Governor Sargent, in an unprecedented action, eliminated the proposed Southwest Expressway and dedicated the already acquired right-of-way (ROW) totally to public transportation, parks and beneficial land developments. The relocation of the Orange Line, the Southwest Corridor Park, and the proposed development of Ruggles Center are major components of the revitalization plan.

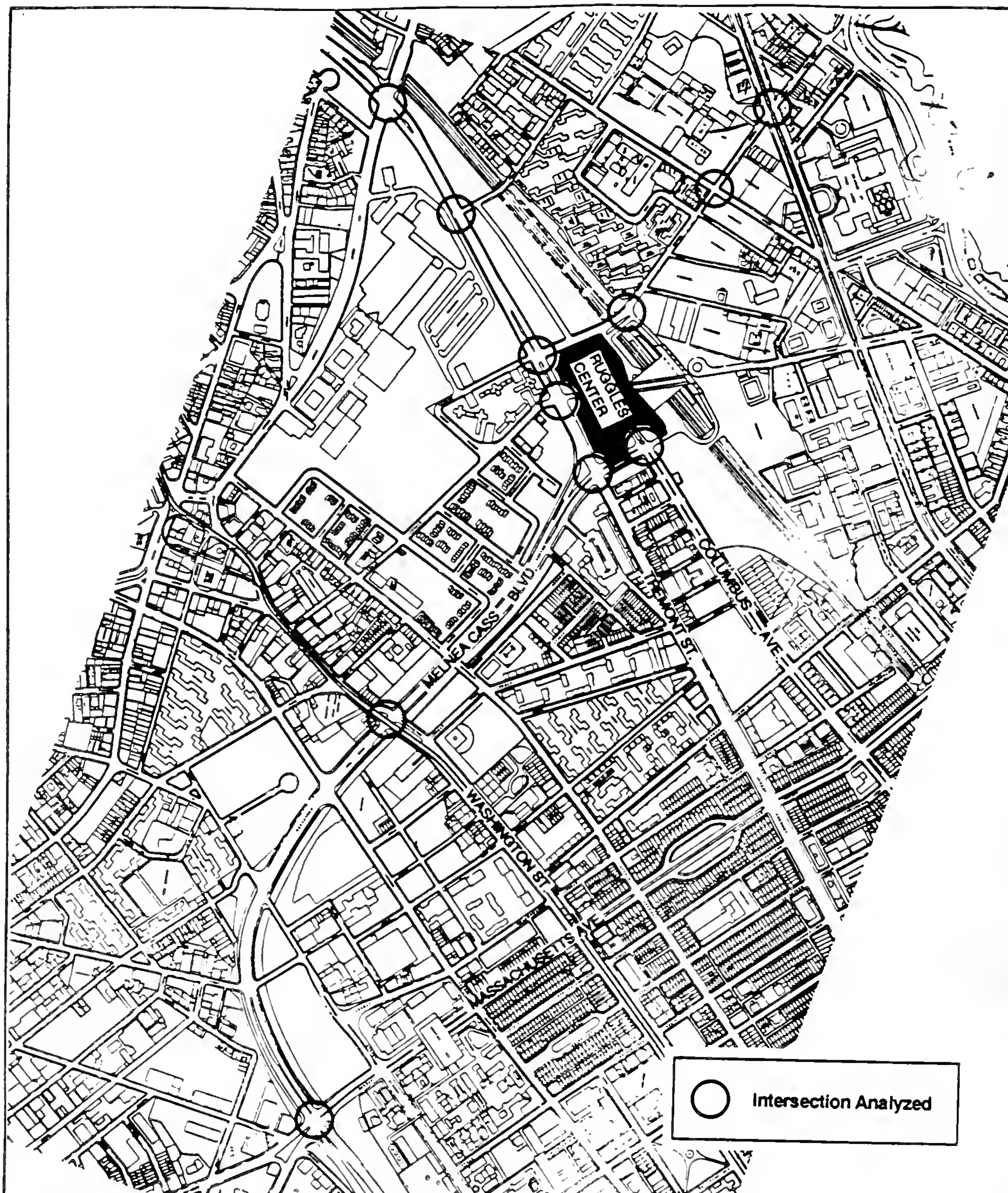
Ruggles Center is located adjacent to Ruggles Street MBTA Station. Consequently, transit access to the station and future MBTA plans for a circumferential transit line through Ruggles Station are key considerations in the site design. Ruggles Center also has excellent access to commuter rail and feeder buses which serve a large work force in Boston's southwest neighborhoods. This feature was taken into account in developing modal choices for the development in the transportation analyses which follow.

The project is of regional significance and enjoys good linkage with the regional highway network as well as the transit system. Both modes are needed for the social and economic success of the project, but a balance is being sought through recognition of the relative importance of the transit investment, roadway network and a reasonable parking supply.

This section provides an update of analyses conducted for the Parcel 18 Draft Environmental Impact Report (DEIR). Since publication of the DEIR, the project has been renamed Ruggles Center and all work on the FEIR is based on the Master Plan Design.

The transportation analysis follows a logical flow. First, the existing transportation system in the project area and it's use are described. Then, for the design year (which has been moved forward to 1996, the target year for full buildout), the DEIR forecasts for 1993 were updated to provide a clear estimate of traffic growth both with and without development of Ruggles Center. The forecasts enabled estimates to be made of the probable impacts of the project on vehicle traffic, parking, the transit system, and pedestrians.

The final section discusses traffic mitigation measures for the Master Plan Design. These are a component in the overall transportation mitigation measures, which include study area roadway and



HOWARD/STEIN-HUDSON ASSOCIATES

Traffic Analysis Study Area

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Figure II A-1

intersection improvements, higher transit use, greater vehicle occupancy (car and vanpools), and increased walking trips and bicycle trips. The section concludes with commitments towards these measures.

Description of Existing Environment

Current traffic flow conditions and data on public transportation and pedestrian activity were obtained by reviewing available information and reports, conducting an engineering reconnaissance of the affected roadway and public transportation facilities and analyzing traffic volume data for key roadway segments and intersections.

Study Area Definition

The traffic impact study area was defined based on a preliminary estimate of the probable impacts that site generated traffic would have on the surrounding street system, as dictated by the MEPA scope. The roadway network as defined for the study area is identified in Figure II A-1. The general limits of the area are: Melnea Cass Boulevard to the north, New Dudley Street to the south, Tremont Street to the east; and along the west by Huntington Avenue. In the DEIR, traffic operations were analyzed at the following eight intersection locations:

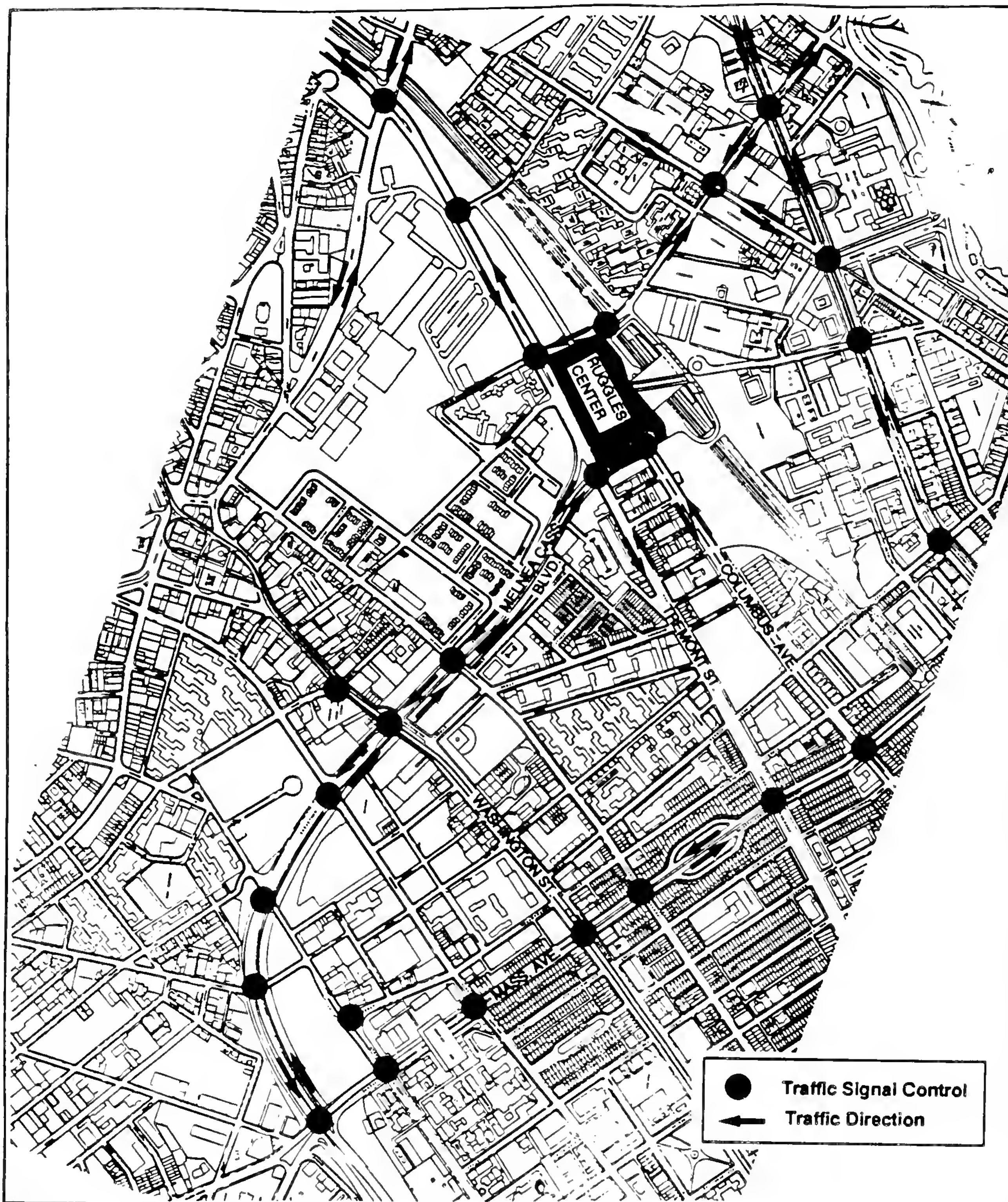
- Tremont/Ruggles/Whittier;
- Tremont/Melnea Cass;
- Ruggles/Busway;
- Tremont/Prentiss;
- Huntington/Ruggles;
- Tremont/Columbus/New Dudley;
- Parker/Ruggles; and
- Columbus/Melnea Cass.

In response to EOTC comments, two intersections were added to the FEIR analysis:

- Melnea Cass/Washington; and
- Melnea Cass/Massachusetts.

Regional Access

Regional access to the Ruggles Center site is provided by the Central Artery/Southeast Expressway (I-93) and the Massachusetts Turnpike (I-90). Arterial streets which provide access from these major highways and the surrounding area include: Melnea Cass



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Study Area Traffic Circulation Patterns

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Figure II A-2

Boulevard, Columbus Avenue, Tremont Street, and Huntington Avenue. Access to the site from the southwest is generally provided along Tremont Street via Columbus Avenue and New Dudley Street or from Huntington Avenue and Ruggles Street. Much of the roadway network in the study area is composed of two-way multi- lane arterial facilities.

The most direct regional connection to the site from the north and the south is along the Central Artery/Southeast Expressway (I-93) via the Massachusetts Avenue interchange and Melnea Cass Boulevard. Regional access from the west along the Massachusetts Turnpike is most direct from the Copley Square interchange and Columbus Avenue, Tremont Street or Huntington Avenue, although ready access is also available from the Turnpike via the Southeast Expressway and the Massachusetts Avenue interchange.

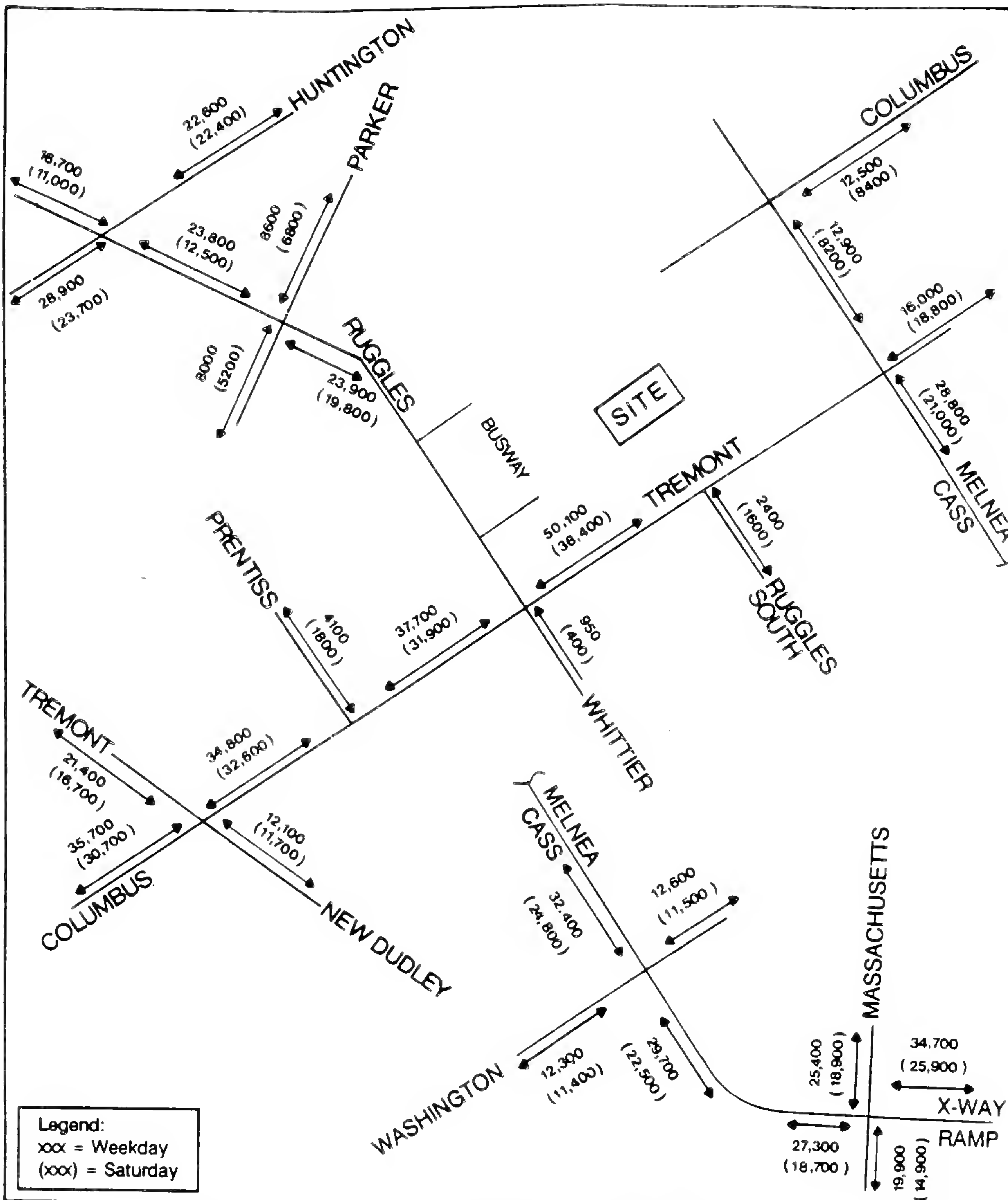
In combination with Ruggles Street, Melnea Cass Boulevard is a major crosstown connector route through the area while other major roadways in the study area are generally oriented in a northeast/southwest direction leading into the Central Business District of the City of Boston. Figure II A-2 depicts the study area traffic circulation patterns and the associated traffic control at intersections locations.

Existing Traffic Volumes

Existing average daily traffic (ADT) volumes are indicated on Figure II A-3. Daily traffic volumes were recorded by Automatic Traffic Recorders (ATR's) placed on various street segments in the Fall, 1988. A summary of these counts is provided in Appendix D.

Daily traffic volume estimates were developed for other street segments by multiplying the peak hour approach volume at selected intersections along the street by the ratio of the recorded daily volume to the peak hour approach volume for the intersecting street.

Hourly traffic data at study area intersection locations for the morning and evening weekday peak hours and the Saturday peak hour were obtained from turning movement counts (counted manually). Traffic volume data were collected in the fall of 1988 by Howard/Stein-Hudson Associates during these peak periods. Results of these counts are shown in Figures II A-4 through II A- 6. A tabular summary is provided in Appendix E.



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Existing (1988) Daily Traffic Volumes

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Figure II A-3

The peak hours of traffic volumes are based on compiling 15-minute count intervals for each intersection location. Some variations in traffic count volumes between adjacent intersections are apparent. Intervening roadways and driveways can account for some differences between adjacent count locations while other variations are evident since the highest peak traffic hour of a series (taken on different days within the same month) were chosen as the peak hour at each location. For example, one intersection can exhibit an evening peak hour between 4:30-5:30 PM, while at an adjacent location, the peak hour might occur from 4:45-5:45PM. Rather than attempting to estimate average conditions by balancing intersection volumes, the highest individual peak hour counts at each intersection location were chosen to establish a probable worst case set of traffic conditions.

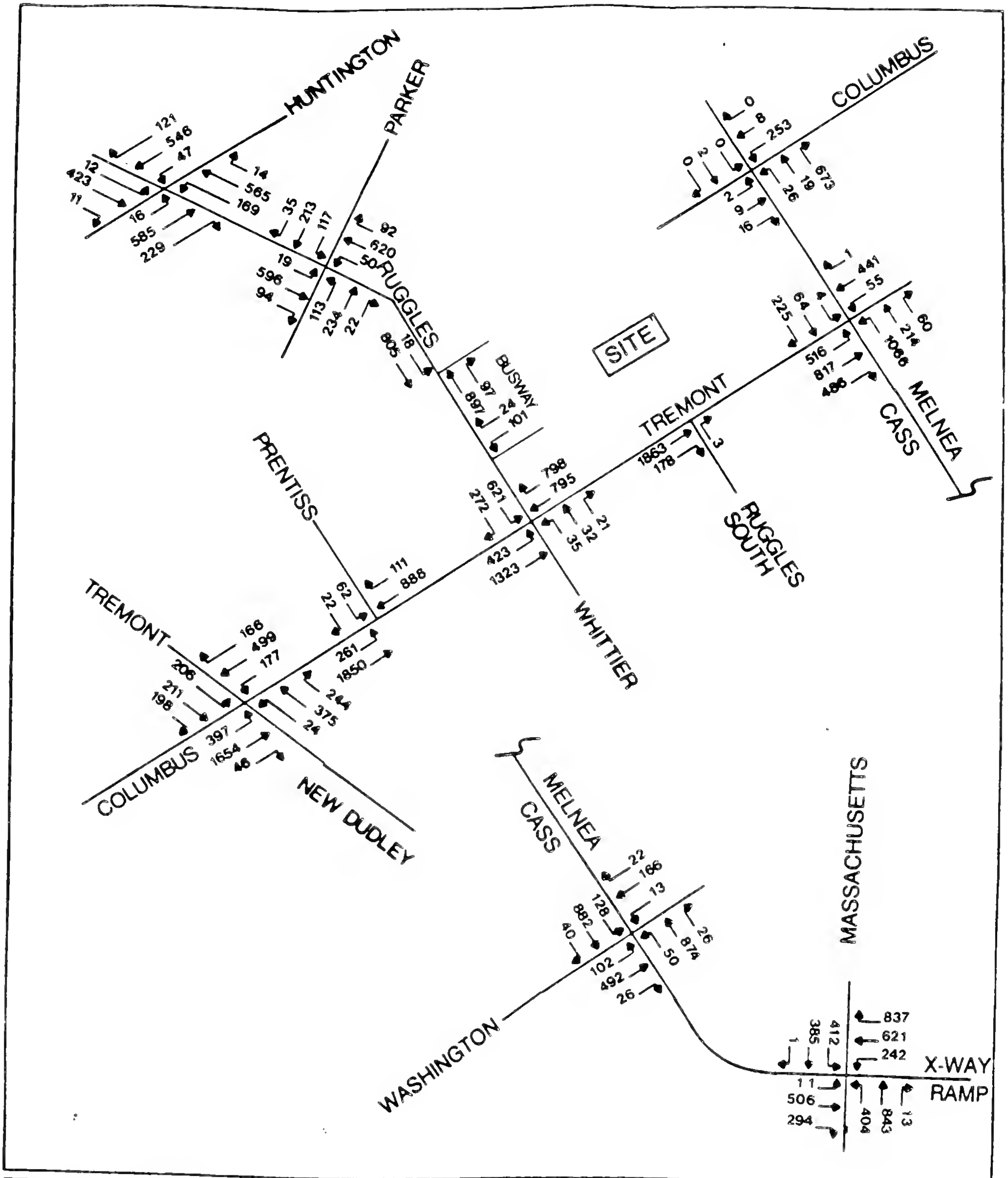
Existing Traffic Operations

Traffic operations are analyzed in terms of level of service (LOS) during these peak hour traffic periods at intersection locations. The capacity of an intersection or roadway facility is the maximum number of vehicles which can be reasonably expected to traverse a roadway segment and/or intersection approach during a specific time period, given the physical and operational characteristics of the facility.

Level of service for signalized intersections is defined in terms of delay. Level of service criteria for signalized intersections are quantified according to the average stopped delay per vehicle over a 15 minute analysis period. The relationship between approach delays and LOS designations for signalized intersections is summarized in Table II A-1.

Level of service criteria for unsignalized intersections are defined by the reserve, or unused capacity of the minor (i.e, controlled) approach. The analysis of unsignalized intersections is based primarily on the ability of vehicles along the minor approach to cross or turn through the traffic stream along the major approaches. This analysis procedure requires that the intersection right-of-way be clearly defined, resulting in a situation where drivers on the minor street must use judgment to select acceptable gaps in the major street flow through which to execute turning maneuvers. Therefore, the capacity of a controlled approach is dependent on two factors:

1) the distribution of gaps in the traffic stream along the major street; and



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Existing Conditions (1988) Vehicular Traffic Volumes:

AM Peak Hour

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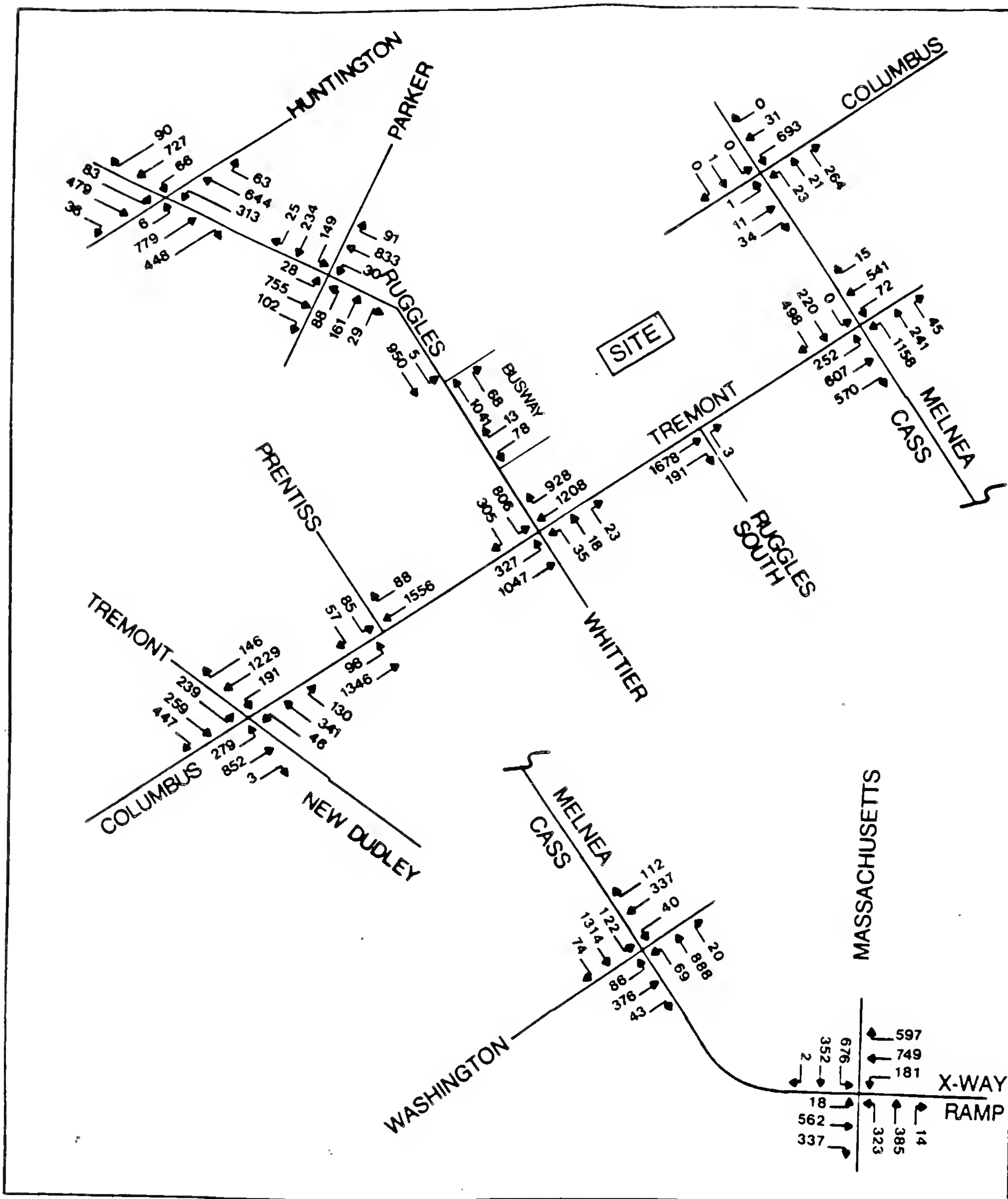
Figure II A-4



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Existing Conditions (1988) Vehicular Traffic Volumes:

PM Peak Hour

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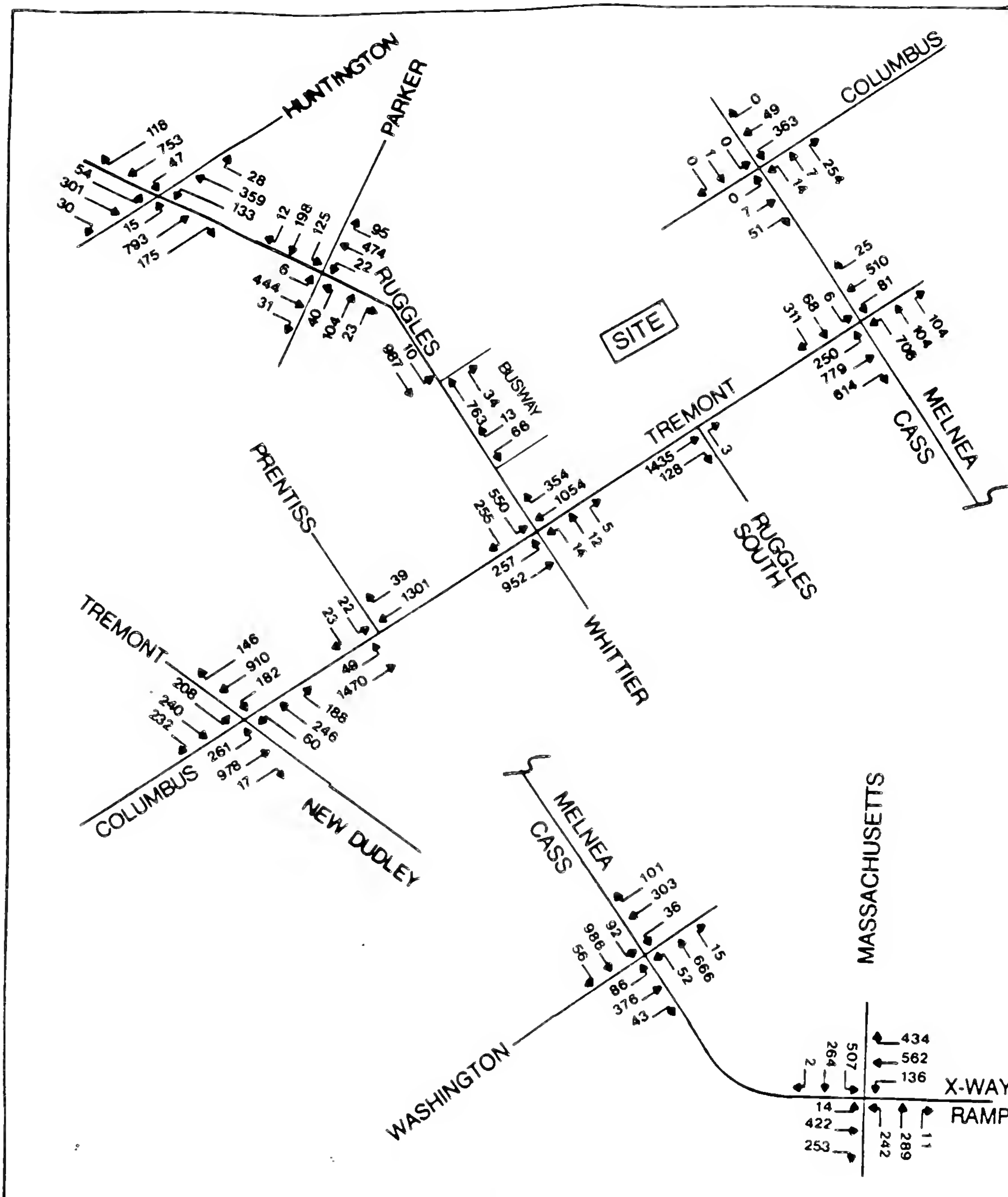
Figure II A-5



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Existing Conditions (1988) Vehicular Traffic Volumes:

Saturday Peak Hour

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Figure II A-6

Table II A-1
Intersection Level of Service (LOS) Designations (1)

Level of Service	Description	Delay Range (2) Seconds per Vehicle	Reserve Capacity (3) (Vehicles per Hour)
LOS A	Describes a condition of free flow, with low volumes and relatively high speeds. There is little or no reduction in maneuverability due to the presence of other vehicles, and drivers can maintain their desired speeds with little or no delay.	0.0-5.0	400
LOS B	Describes a condition of stable flow, with desired operating speeds relatively unaffected, but with a slight deterioration of maneuverability within the traffic stream.	5.1-15.0	300-399
LOS C	Describes a condition still representing stable flow, but speeds and maneuverability begin to be restricted. The general level of comfort begins to deteriorate noticeably at this level.	15.1-25.0	200-299
LOS D	Describes a high-density traffic condition approaching unstable flow. Speeds and maneuverability become more seriously restricted, and the driver experiences a poor level of comfort.	25.1-40.0	100-199
LOS E	Represents conditions at or near the capacity of the facility. Flow is usually unstable, and freedom to maneuver within the traffic stream becomes extremely difficult.	40.1-60.0	0-99
LOS F	Describes forced-flow or breakdown conditions with queueing along critical approaches. Operating conditions are highly unstable as characterized by erratic vehicle movements along each approach.	60.1 or greater	N/A

---

1) Source: Transportation Research Board, Highway Capacity Manual, Special Report 209, National Research Council, 1985.
2) Delay ranges relate to the mean stopped delay incurred by all vehicles entering the intersection for the movement or movements under consideration and do not consider the effects of traffic signal coordination. This criterion is intended for use in the evaluation of signalized intersections.
3) Reserve capacity refers to the unused capacity of the minor approach, on a per lane basis. This criterion is limited to use in the evaluation of unsignalized intersections.

2) driver judgment in selecting gaps in the major stream through which to execute turning movements.

The volume using the major intersection approaches is a governing factor in the capacity determination for the minor approach. The reserve capacity at the minor approach is subsequently determined by calculating the difference between the capacity of the intersection at LOS F and the actual approach volume, adjusted to account for traffic stream characteristics and intersection geometrics. Reserve capacity is usually defined on a per lane basis for a peak hour analysis period.

From a traffic operations standpoint, LOS C or better is generally considered an acceptable condition. LOS D is considered acceptable in urban conditions. LOS D represents conditions where the peak hour demands are less than the capacity of the roadway or intersection, but where speeds are considerably reduced and delays increased. LOS E represents operations at or near capacity where delays to critical approaches are significant. The traffic operations analyses for existing, No Build and Build conditions are provided in Appendix F.

Traffic operations analysis for existing conditions assumes enforcement of existing parking restrictions. Traffic restrictions, specifically peak hour no left turn prohibitions, are assumed not to be enforced under existing traffic operating conditions, as traffic counts indicate. In addition, the analyses assume signal timings are fully actuated and optimized. Although current lack of parking restriction enforcement measures (tow zones) and non-optimized signal timings produce poorer traffic operations at certain locations than those indicated in the analyses, the results are used as a base for comparison purposes with the No Build conditions.

For the 1996 analysis year, the traffic operations analyses were conducted assuming full enforcement of existing traffic and parking regulations along study area streets. Traffic signal operations are also expected to be improved with implementation of the City's Traffic Signal Coordination Program. These results are used for comparative purposes with the No Build and Master Plan Design conditions.

Since the traffic operations analysis contained in the DEIR was completed, pavement restriping along the Tremont Street Corridor from New Dudley Street to Ruggles Street has provided for the use of

the breakdown lane as a travel lane. This change has effectively increased the number of lanes in use along this portion of Tremont Street from two lanes to three lanes in both directions. All traffic operations analyses in this report (Existing, No Build and Build) reflect this change.

Table II A-2 shows existing traffic operations at study area intersections for weekday morning, weekday evening, and Saturday afternoon peak hours. The intersection capacity analyses were conducted in accordance with the guidelines of the Transportation Research Board's Highway Capacity Manual (Research Report 209), utilizing the Capacity of Intersections: CTPS' HCM Program (CINCH) as suggested in the EOEA guidelines for traffic impact analyses.

The analyses indicate traffic operations at study area intersections to be at acceptable levels of service (LOS D or better) during the morning peak hour period. The intersection of Parker/Ruggles and Melnea Cass/Massachusetts/Southampton/ X-Way ramps are the only locations during the morning peak hour that operate at LOS D; all other locations operate at LOS C or better. During the Saturday peak hour, all intersections analyzed operate at LOS C or better.

Traffic operation indicators during the evening peak hour are generally worse than those of the morning and Saturday peak hour periods. During the evening peak hour, seven of the ten intersection locations analyzed operate at LOS C or better. Three intersections exhibit unacceptable traffic operations: Huntington/ Ruggles (LOS E); Tremont/Melnea Cass (LOS F); and Parker/Ruggles (LOS F).

Overall, existing peak hour traffic operations within the study area are marginally acceptable or better, except during the weekday evening peak hour period where two intersections along Ruggles Street and one intersection on Tremont operate at unacceptable conditions.

Public Transportation System

Excellent public transit facilities and services are an integral component of the overall development at the Ruggles Center site. The new Orange Line Ruggles station and Ruggles Center are mutually supportive. The transit service gives access to and allows fairly dense development to take place while, in turn, the project provides significant new transit system patronage.

Table II A-2
Existing (1988) Conditions - Traffic Operations Summary

SIGNALIZED INTERSECTIONS

Intersection Location	AM PEAK HOUR LOS	AM PEAK HOUR Average Delay*	PM PEAK HOUR LOS	PM PEAK HOUR Average Delay	SAT PEAK HOUR LOS	SAT PEAK HOUR Average Delay
Tremont/Ruggles/Whittier	B	15	C	20	B	12
Tremont/Melnea Cass	C	24	F	65	C	21
Ruggles/Busway	B	5	A	4	A	3
Tremont/Prentiss	A	3	A	5	A	2
Huntington/Ruggles	B	14	E	51	B	12
Tremont/Columbus/New Dudley	C	16	C	21	C	18
Parker/Ruggles	D	34	F	63	B	15
Melnea Cass/Columbus	A	5	A	4	A	4
Melnea Cass/Washington	B	12	B	12	B	11
Melnea Cass/Massachusetts/ Southampton/X-Way Ramps	D	26	C	22	C	19

* in seconds

Ruggles Station is one of the key new stations along the MBTA's relocated Orange Line. The new station was designed by the MBTA to accommodate a projected 8,000 riders per day. The Orange Line station and the commuter rail stop provide the chief links between the project site and the regional transit and commuter rail network. They connect the site with the downtown rapid transit and light rail transfer points, as well as with both North and South Stations, major regional and intercity rail and bus nodes. Figure II A-7 shows the transit services at and near the Ruggles Center project site. Figure II A-8 illustrates the Ruggles Station area, including the busway into the station and the proximity of the commuter rail, rapid transit, and bus facilities. Ruggles Station is presently served by fourteen local MBTA bus routes. These are:

Route 8:	Ruggles - Columbia Point
Route 15:	Ruggles - Kane Square or Fields Corner
Route 17:	Ruggles (or Andrew) - Fields Corner
Route 19:	Ruggles - Fields Corner
Route 22:	Ruggles - Ashmont via Talbot Avenue
Route 23:	Ruggles - Ashmont via Washington St.
Route 28:	Ruggles - Mattapan via Dudley Square
Route 29:	Ruggles - Mattapan via Jackson Square
Route 42:	Ruggles - Forest Hills
Route 43:	Ruggles - Park and Tremont Streets
Route 44:	Ruggles - Franklin Park Zoo via Seaver Street
Route 45:	Ruggles - Franklin Park Zoo via Blue Hill Avenue
Route 47:	Central Square, Cambridge - Andrew Station
Route 47A:	Kenmore Station - Boston City Hospital

All of the routes, except the 47 and 47A, terminate at Ruggles Station. On a daily basis, 990 buses come into the station, with 120 of these providing service during the peak hour. Peak hour headways vary from 5 to 30 minutes, depending upon the route. The majority of the buses arriving at the station are coming from the south on Tremont Street, turning left onto Ruggles Street and entering the station busway. Return trips travel along the same route. These bus lines were designed to provide feeder service to the Orange Line, but will, of course, provide direct access to Ruggles Center from their large service area. As an indicator of the ridership in the corridor, daily boardings on these routes, which may not all involve a trip through Ruggles, are estimated at around 75,000 by the MBTA, as shown in Table II A-3.

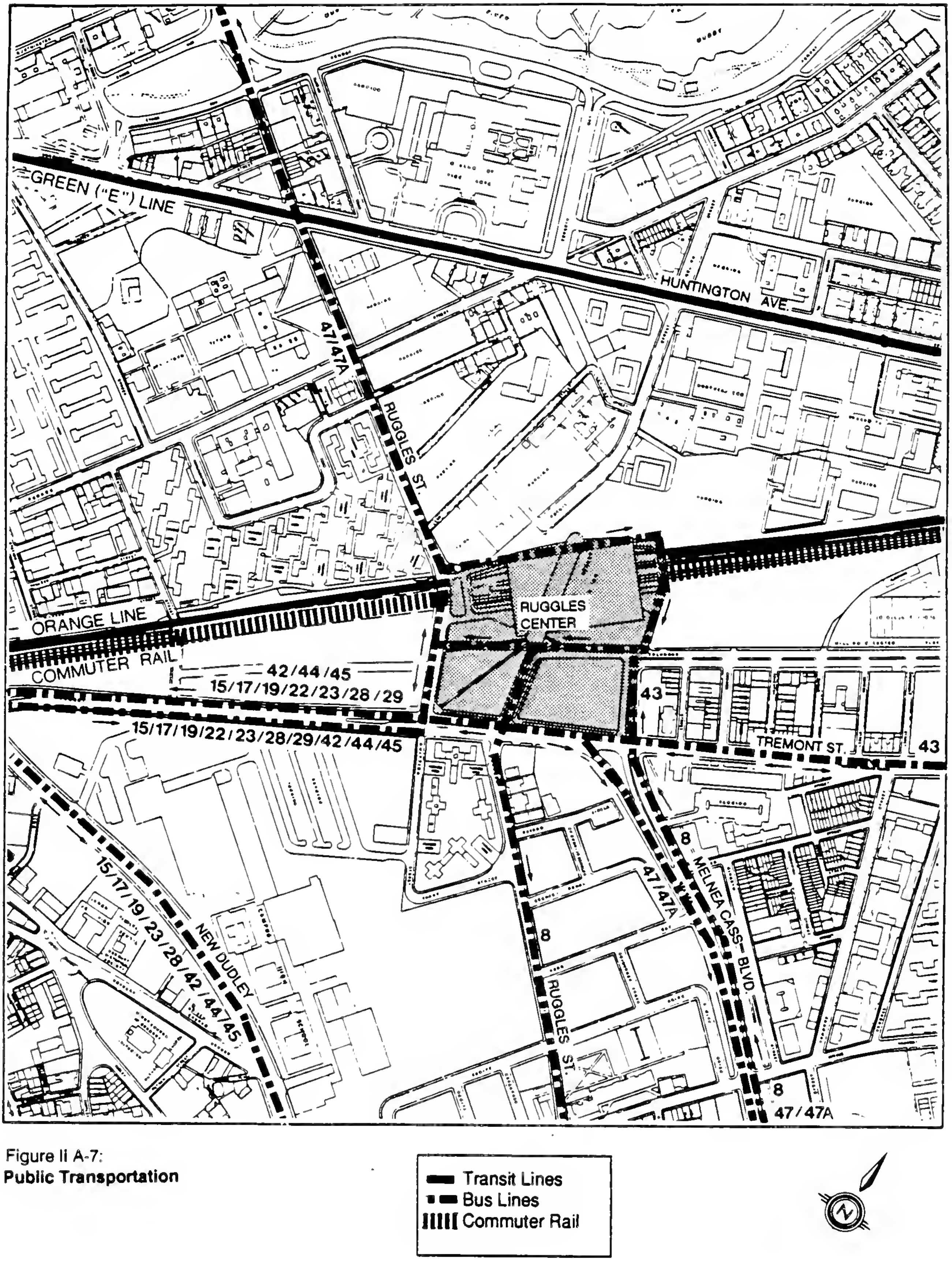


Figure II A-7:
Public Transportation

Table II A-3

Estimate of Daily Boardings (Total Inbound and Outbound): Ruggles Station Feeder Bus Network

No.	Route	Weekday Ridership	# Peak Hr. Buses AM	PM
8	Columbia Pt./Ruggles Station via Edward Everett Square	1,263	4	4
15	Kane Square or Field's Corner/ Ruggles via Uphams Corner	5,421	8	8
17	Field's Corner/Andrew or Ruggles via Uphams Corner	3,841	5	5
19	Field/s Corner/Ruggles via Warren Street & Grove Hall	1,254	4	4
22	Ashmont/Ruggles via Talbot Ave. and Jackson Square	5,405	7	7
23	Ashmont/Ruggles via Washington St.	10,748	12	11
28	Mattapan/Ruggles via Dudley Square	7,118	6	5
29	Mattapan/Ruggles via Jackson Square Station	12,136	10	10
42	Forest Hills/Ruggles via Washington Street and Dudley Square	1,740	4	4
43	Ruggles Station/Park & Tremont Streets via Tremont Street	9,201	8	5
44	Franklin Park Zoo/Ruggles via Seaver St. and Humboldt Avenue	4,815	9	7
45	Franklin Park Zoo/Ruggles via Blue Hill Avenue	4,618	9	7
47	Central Square, Cambridge/Andrew Station via Dudley Square	5,731	3	4
47A	Longwood Medical Area/Boston City Hospital via Dudley Square	2,032	6	4
	Total	75,296	95	85

Source: MBTA

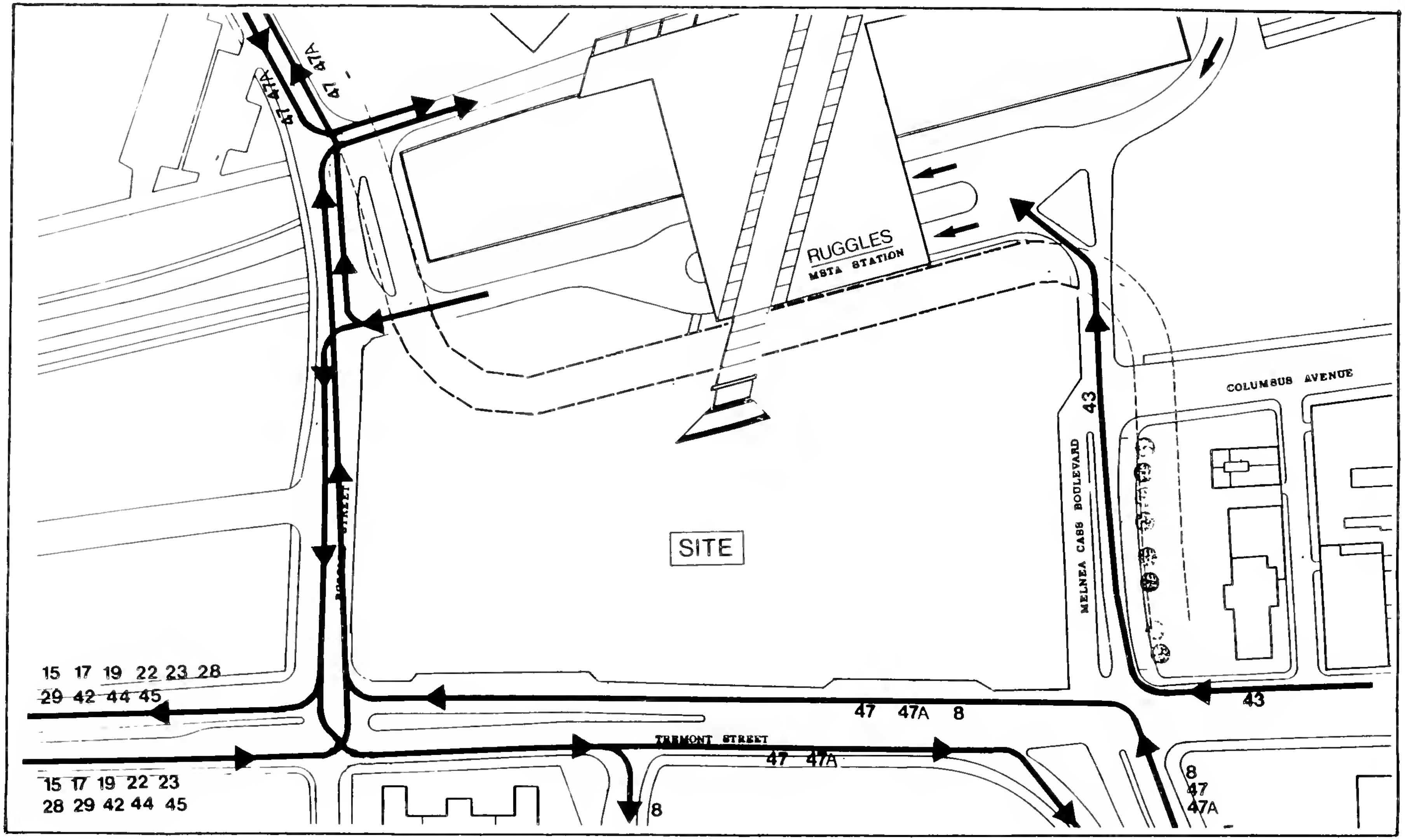


Figure II A-8:
Ruggles Station Bus Route Circulation

It is of note that the bus routes provide a one-seat, fifty cent ride directly to Ruggles Center to a large labor force within the southwest portion of Boston, as shown in Figure II A-9. Estimates based on 1980 population data are that a labor force of 62,000 live within the bus route service area (BRA, 1985.)

The MBTA's Arborway branch of the Green Line passes less than one- half of a mile to the north of Ruggles Center. Currently, the MBTA runs trolley service on this line only as far south as Brigham Circle, with the Route 39 bus providing service to points south. In September, 1989, the MBTA announced reinstitution of trolley service on Huntington Avenue as far as Heath Street. In the long term, if the MBTA resumes trolley service to Arborway, this line will provide additional transit access to points south and west of the site. Pedestrian improvements planned by Northeastern University will provide a direct connection via Forsyth Street from the site to the trolley stop on Huntington Avenue.

Existing Transit Capacity and Ridership

In order to estimate the impact of the project on the transit system and the system's capacity to serve the development, existing and future transit capacity and ridership figures have been developed. In this analysis, emphasis has been placed on the rapid transit system, as this is the primary means of providing transit service to the project site. While project employees and visitors are expected to use MBTA buses as well, the MBTA has a policy of expanding bus service as ridership grows. Thus, they are not as capacity constrained as the fixed rail systems, assuming availability of buses.

The concept of transit system capacity is defined in terms of the passenger carrying capability of the transit vehicles for a given time period, typically a peak 2-3 hour period or a one-hour peak. Line capacity for a given transit schedule is a function of the number of trains per hour, the number of cars per train, and the number of passengers per car. For this study, capacity was estimated through the following steps:

1) determining for each line the number of peak hour trains (sixty minutes divided by the scheduled headway). To meet a given schedule for trains in both directions may require more or fewer total trains than will actually pass through a checkpoint in the peak hour, depending on the running time for the round trip.

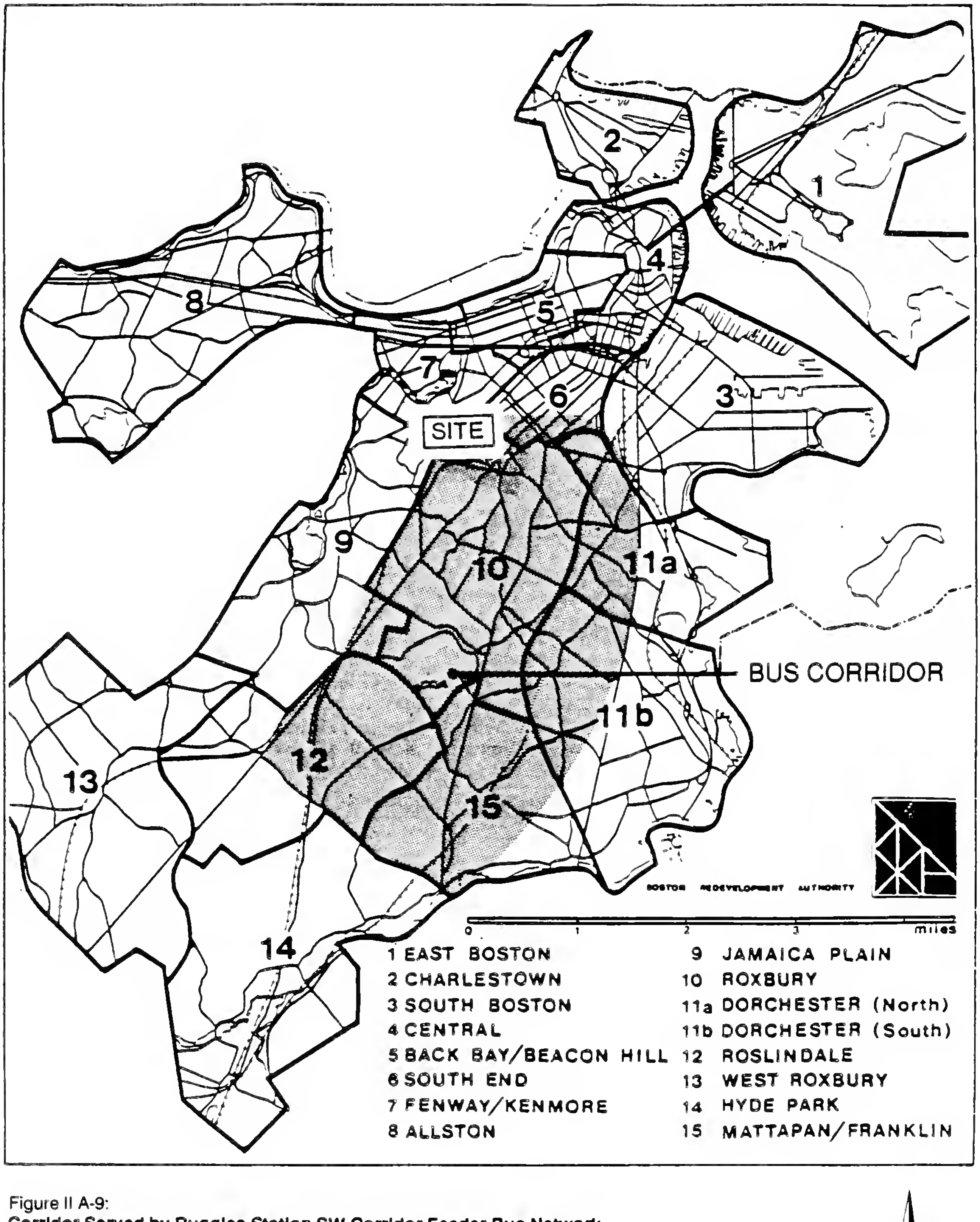


Figure II A-9:
Corridor Served by Ruggles Station SW Corridor Feeder Bus Network

Thus, the total number of trains available will not equal the actual number of trains running in the peak one hour period.

2) calculating the total number of peak hour cars -- number of trains multiplied by number of cars per train. This parameter varies for each line.

3) calculating the total number of passengers -- number of cars multiplied by the passenger carrying capacity of each car. For this study, capacity is defined as the seating capacity for each type of car, plus the number of standees which could be accommodated at 2.5 square feet per person -- or approximately 3 passengers per seat. This is equivalent to a "Level of Service E" according to the Highway Capacity Manual. By comparison, "crush loading" is defined as 3.8 passengers per seat.

The data upon which current transit line capacity calculations have been based is included in Table II A-4. Table II A-5 compares these theoretical capacities to current ridership figures for the peak direction at the peak station/link in the peak hour for the Orange and Green Lines.

As seen below, the Orange Line has sufficient capacity, even at its peak load point, between Back Bay/South End and New England Medical Center Stations, to carry existing peak passenger loads. At Ruggles Station, which lies beyond the peak load point, the trains have not yet reached peak boardings in the morning, and riders have already started alighting in the evening. Thus, additional capacity is available to accommodate riders coming from the southwest. This is a most desirable feature of planning high density development outside the core area in terms of transit operations and effective utilization of peak vehicle capacity.

Pedestrian Environment

Presently, the Ruggles Center site generates little pedestrian activity. Current pedestrian activity consists primarily of walk- in transit and bus passengers. The opening of Ruggles Station and the completion of the Southwest Corridor Park have helped to introduce activity and improve security in the area, although the wide streets, heavy traffic, and high bus volumes still make the environment intimidating for pedestrians.

As illustrated in Table II A-6, observations taken during July

Table II A-4
Existing (1988) MBTA Rapid Transit Peak Hour Capacity

Line/Segment	PM Peak Cars/ Train	PM Peak Sched. Headway	PM Peak Hr. Trips	PM Peak Hr. Cars	Car (Design) Capac.	PM Peak Hr. Capac.
ORANGE		4.5 min				
Oak Grove - Forest Hills	6		11	66	155	10,230
	4		3	12	155	1,860
Total			14	78		12,090
GREEN						
N. Sta. - Cleveland Cir.	2	7 min	9	18	140*	2,520
Gov't Center - Boston Col	2	6 min	10	20	140	2,800
Gov't Center - Riverside	3	6 min	4	12	140	1,680
	2		6	12	140	1,680
Gov't Center - Reservoir	1	10 min	6	6	140	840
Brigham Circle - Lechmere	2	8 min	8	16	140	2,240
Total			43	84		11,760
RED						
Alewife - Ashmont	4	8 min	4	16	180	2,880
	6		4	24	180	4,320
"Run As Directed"(RAD)	6		1	6	180	1,080
Total, Ashmont			9	46		8,280
Braintree - Alewife	4	8 min	3	12	180	2,160
	6		5	30	180	5,400
Run As Directed (RAD)	6		2	12	180	2,160
Total, Braintree			10	54		9,720
Total			19	100		18,000
BLUE						
Bowdoin - Wonderland	4	3.5 min	17	68	110	7,480
Run as Directed" (RAD)	4		1	4	110	440
Total			18	72		7,920
TOTAL TRANSIT LINES			94	334		49,770

Source: MBTA, Operations Directorate, Planning Division:
Ridership and Service Statistics, October, 1988
Letter from Michael Burns, December, 1988 (see Appendix G)
*Tom Humphrey, CTPS

** Note: excludes Mattapan trolley service feeding Ashmont Station

Table II A-5
Existing (1988) Transit Capacities and Ridership
Peak Hour, Peak Direction

Peak Load Points	Peak Hr. Capacity*	Av. Passenger Load **	Volume/ Capacity
ORANGE LINE NORTH			
Between Haymarket		9,300 (AM)	.77
and North Station	12,090	8,900 (PM)	.74
ORANGE LINE SOUTH			
Between Back Bay		8,800 (AM)	.73
and New England Med. Ctr.	12,090	7,650 (PM)	.63
GREEN LINE (BRIGHAM CIRCLE)	2,240	1,460 (AM) ***	.65

* See Table II A-4 for capacity calculation.

** Source: MBTA Ridership and Service Statistics, Operations Directorate, Planning Division, October, 1988 page 2-8, and letter from Michael Burns to Howard/Stein-Hudson, December, 1988 (see Appendix G).

*** Ibid., page 2-10, and Howard/Stein-Hudson Associates estimates.

and August 1989 at the Ruggles MBTA station dropoff/pickup area, indicated that 186 people walk in or out of the station at this location between the morning peak hour of 7:30-8:30AM. During the PM peak hour (4:30-5:30PM) 206 pedestrians enter or exit the station at this location. Refer to Appendix G for complete pedestrian/bicycle survey results.

Table II A-6

Pedestrian and Drop off/Pick up Activity
at Tremont Street Entrance, Ruggles Station

	AM PEAK HOUR			PM PEAK HOUR		
# of Persons	IN	OUT	Total	IN	OUT	Total
Pedestrians	129	31	160	36	134	170
Pick up/Drop off	16	10	26	15	21	36
Total	145	41	186	51	155	206

Of the total pedestrian activity observed in the morning peak hour, 160 people (86%) walked to their destinations while 26 people (14%) were dropped off or picked up by vehicles. In the evening peak period, 170 people (83%) walked to their destinations and 36 people (17%) were dropped off or picked up. It is assumed that those people walking in the morning and evening peak periods, crossed Tremont Street to get to their destinations, since the only development currently in the area are residences on the west side of Tremont Street. Those who were dropped off or picked up do so on the Ruggles Center site and do not cross Tremont Street. Based on these peak period observations, existing crosswalk flow was considered moderate (200 pedestrians or less per hour) for purposes of the traffic capacity analyses.

Bicycles

As part of the Southwest Corridor Park, a bicycle path extends the length of the five mile corridor from Jamaica Plain to Back Bay. At points on the corridor, there are exclusive paths for bicyclists, while at

other locations bicycles share the path with pedestrians and/or vehicles.

Howard/Stein-Hudson observations at the dropoff/pickup area for Ruggles Station (July/August 1989) found that 34 bicycles pass this location during the morning peak hour (8-9AM) and 41 bicycles pass this location during the evening peak hour (5-6PM). The number of bicycles for the morning and evening peak periods are detailed in Table II A-7. Immediately south of this location, there are separate paths for pedestrians and bicyclists. However, the two paths end at the station entrance and bicyclists and pedestrians use the same sidewalk in front of the drop off/pick up area. Some bicyclists go into the street area at this point, conflicting with vehicles using the drop off/pick up area. The single sidewalk continues north of this point, but is lightly used by pedestrians.

Parking

Parking in the study area consists of several off-street surface parking areas (primarily for Northeastern University commuter students) and on-street spaces (primarily for residential and local retail development). No parking is currently allowed along Melnea Cass Boulevard or Tremont Street. On-street parking is allowed along Columbus Avenue north of Melnea Cass Boulevard, with peak hour restrictions. A small number of spaces are located north of Ruggles Street on Leon Street.

The observed demand for on-street parking spaces is high throughout the day. A recent parking demand inventory conducted by Sasaki Associates for the Northeastern University Campus Master Plan showed parking space use at or above practical capacity (95% space occupancy) from the morning peak hour through the mid-afternoon, largely due to student parking.

Traffic Assumptions

Trip Generation Rates

To determine the comparative transportation impacts of the No Build (1996) development and the Master Plan Design development option, the standard transportation planning process of trip generation, mode split, trip distribution, and network assignment was used, as discussed below.

Basic to a determination of development project transportation impacts is the estimation of the trips which the project will generate in

Table II A-7

Bicycle Activity Passing Tremont Street Entrance, Ruggles Street Station

Date	Time Ending	Bicycles (Passing By)	Date	Time Ending	Bicycles (Passing By)
8/2/89	7:15AM	6	8/2/89	4:15PM	9
	7:30AM	6		4:30PM	6
	7:45AM	5		4:45PM	12
	8:00AM	7		5:00PM	7
	8:15AM	7		5:15PM	7
	8:30AM	8		5:30PM	11
	8:45AM	12		5:45PM	8
	9:00AM	7		6:00PM	15
	Total AM Peak Period	58		Total PM Peak Period	75

various time periods of interest, and for various travel modes. In the case of the Ruggles Center proposed development, besides looking at the trips generated during an average weekday and in the morning and evening hours of peak travel, the MEPA scope for environmental documentation also asks that trip-making for an average Saturday peak hour be included.

As a basis for trip generation in this report, the Institute of Transportation Engineers (ITE) Trip Generation Manual was used. It is one of the major references used in the estimation of trip generation and presents trip generation rates for a wide variety of land uses based on surveys of actual developments located at various sites across the country. It is also the only major reference which deals directly with Saturday trip-making, a requirement for this report. Another feature of the Manual is that for many land uses, notably office and shopping, trip rates are adjusted according to the size of the development, as found in survey work.

The rates in the Manual deal with vehicle trips only, and in dominantly suburban settings where transit service is negligible. There is also no overt consideration of car occupancy as a variable factor, nor any division between journey to/from work and other trips. In order to apply these rates to Ruggles Center where transit and walk-in trips will play substantial access roles, the Manual vehicle trip rates were converted to person trip rates. The person trips were then broken down into the various travel modes (automobile, transit, walking) and work/non- work categories. Vehicle trips were obtained by dividing auto person trips by appropriate car occupancy factors.

In this report, person trips were obtained from the ITE vehicle rates by conversion factors related to ITE probable car occupancies and an allowance for some nominal transit and walk access. The resultant person trip rates for each activity and time period and land use for each development option were also compared for compatibility with person trip rates found in other Boston transportation sources.

These Boston sources included Central Transportation Planning Staff (CTPS) interim trip generation rates related to the Central Artery project, the Draft Access Plan Guidelines of the Boston Transportation Department (BTD), and a number of EIRs for previous Boston developments. These were referenced for consistency checks and used for the estimation of the division between work and non-

work trips. The person trip rates are adopted for each land use by analysis period, divided into work and non-work categories. (It may be noted that a work trip includes only the journeys to or from the place of employment. Additional trips made by employees, even on business, would be considered non- work.)

In order to give a more detailed record of the actual basis for the rates adopted, the person trip generation rates for each land use are discussed below. It should be noted that office land use is the largest component of Ruggles Center, so that office trip rates have the greatest impact on the total trip generation.

Office Person Trip Rates

The ITE rates vary according to the size of the office development, with larger developments having lower trip rates per 1,000 square feet (SF). This is related in part to the fact that larger office buildings have fewer employees per unit area and that more non-work trips are satisfied on-site. As the Manual recommends, the rates were calculated by using the equations given for the different time periods considered. For calculation of the proportion of work and non-work trips, total person trips were divided in accordance with the interim CTPS work/non-work proportions for the corresponding time period.

The ITE Manual notes that the average car occupancy for office trips surveyed for the Manual is 1.2 persons. The Manual vehicle rates per 1,000 SF for General Office (Land Use Code 710) were multiplied by this 1.2 factor and further augmented by 10% to allow for nominal transit and walk-in access which is low or non- existent in the Manual. This resulted in a conversion factor of 1.32, with weekday person trips rates around 11 or 12 arrivals and departures, compared to a CTPS interim rate of 13.4. The Ruggles Center rates are a little lower because the CTPS rate is constant and intended to represent an average development, which is smaller than the office component of the Ruggles Center Master Plan Design. The conversion factor used would be equivalent to the CTPS rate at an office development size of about 300,000 SF.

Retail Person Trip Rates

In a manner generally similar to the estimation of office rates, the ITE Manual retail (Shopping Center, Land Use Code 820) vehicle rates per 1,000 SF were factored to produce person trips. The rates were not, however, established according to the precise size of the retail component alone. This is because the Manual rates apply to freestanding retail developments in suburban locations, where few, if any other

retail shops or other developments are within walking distance. In the case of Ruggles Center the relatively small ground floor retail development cannot be seen as an isolated small retail center, but should be put in the context of the relatively densely settled area where it is located, including the on-site office, nearby Northeastern University, and adjacent housing. The ITE rates used for the Master Plan Design were therefore calculated at a level of 300,000 SF to represent the amount of retail space in the overall district.

A factor of 1.7, representative of the car occupancy of retail customers, was used to convert vehicle trips in the Manual to person trips for each time period analyzed. The resulting weekday person arrivals and departures are about 82, compared to a CTPS interim retail rate of about 60, and a BTD Draft Access Plan Guidelines general retail rate of about 37 person trip in and out, both intended for more central Downtown locations. The various time period rates were divided into work and non-work components according to the corresponding retail proportions in the CTPS/BTD rates.

Hotel Person Trip Rates

ITE Manual vehicle trip rates per room for hotels (ITE Land Use Code 310) for the various time periods were converted into person trips by a factor of 2.0, which was chosen to calibrate to the common CTPS and BTD weekday person rate of just over 17 person arrivals and departures per room. Work and non-work components were derived by the proportions of such trips in the corresponding time periods of the CTPS/BTD rates, as with the other land use types.

Day Care Center Trip Rates

Person trip rates for the day care center were derived from the ITE vehicle trip rates for this land use, adjusted by an average car occupancy of 1.3 to obtain person trips. A breakdown of 10% work trips and 90% non-work trips was assigned for this use.

Modal Split and Vehicle Occupancy

The vehicle occupancy and modal split factors used in the above trip generation rate conversion process were necessary to convert ITE Trip Generation Manual vehicle trips to basic person trip rates for Ruggles Center analysis. The factors relate to ITE Manual conditions linking Manual surveyed development vehicle trips to the number of persons involved. Once the person rates are established, vehicle occupancy and modal split factors relevant to Ruggles Center are needed.

Modal split factors are first used to assign person trips for each

Table II A-8

Trip Making Characteristics by Land Use to Ruggles Center (Lower Roxbury)

Land Use	Auto	Vehicle Occupancy	Transit	Walk/ Other
	Percentage Share			
Office				
Work	46%	1.24	44%	10%
Non-work	48%	1.72	30%	22%
Retail/Cultural				
Work	46%	1.24	44%	10%
Non-work	48%	1.72	24%	28%
Hotel				
Work	46%	1.24	44%	10%
Non-work	59%	1.72	19%	22%
Day Care				
Work	46%	1.24	44%	10%
Non-work	20%	1.72	30%	50%
Residential				
Work	31%	1.24	59%	10%
Non-work	39%	1.72	41%	20%

Sources: CTPS, Howard/Stein-Hudson Associates Estimates

land use to the appropriate mode of transportation; i.e., automobile, transit, or walk/other (taxi, bike, etc.). For the vehicle trips, person trips are then converted to auto trips by vehicle occupancy factors (i.e., the number of persons per car) for each type of trip.

Mode split and vehicle occupancy tend to vary between different land uses due to the specific trip making characteristics related to each. The distinction between various mode split and vehicle occupancy factors also applies to the type of trip being made, most commonly defined in terms of work and non-work trips. Mode split and vehicle occupancy is also heavily influenced by the location of the particular development, especially in terms of vehicular and transit accessibility and parking availability and price.

The identification and application of these land use specific mode split and vehicle occupancy factors is generally limited to large scale development where they will produce a noticeable difference in overall trip generation, trip assignment and trip distribution. This effort is warranted by the scale and location of Ruggles Center.

The mode split and vehicle occupancy factors for the general Lower Roxbury location of the Ruggles Center development are expected to be different from those of downtown Boston locations. The location of Ruggles Center, adjacent to the MBTA's Orange Line rapid transit facility (Ruggles Station), is unique to the area in terms of transit access. Ruggles Station serves as a major link to the rapid transit network for commuter rail connections to the southwest and feeder bus connections from areas within Boston, mostly to the southeast, southwest and Cambridge. In addition, City goals for this "parcel to parcel linkage" project include outreach to make employment opportunities available to the City's labor force. Previously identified estimates have shown a labor force of 62,500, many of whom are transit dependent, living within the Ruggles Station feeder bus network service area. For these reasons, the mode split to transit is expected to be somewhat higher than the CTPS modeled level for the Lower Roxbury area.

Table II A-8 presents an estimate of the mode split and vehicle occupancy expected for development of Ruggles Center given the unique availability of transit adjacent to the site. These estimates are based on a compilation of mode split data for Lower Roxbury obtained from CTPS and data from downtown Boston developments which are conveniently located with respect to transit. These data were developed by assuming the Ruggles Center site has as good transit access for

Boston residents as downtown Boston locations, while transit access for non-Boston residents is the same as that for Lower Roxbury as a whole. Appendix I presents a complete breakdown of person and vehicle trips by land use.

Ruggles Center Assumptions

Trip Rates

The trip generation rates and associated parameters described in the preceding sections were applied to the Master Plan Design land uses individually to yield project generated person trips by mode. A summary of land uses for this alternative is presented in Table II A-9.

Table II A-9
Master Plan Design: Breakdown by Land Use Category

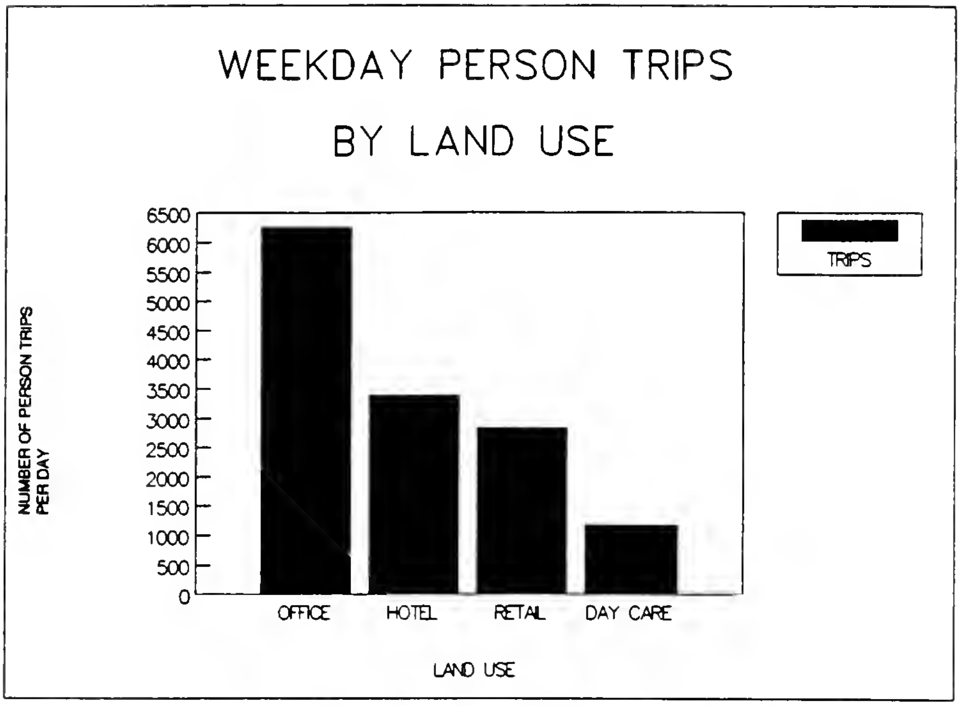
Land Use Category	Units
Office	508,875 gross square feet
Retail	34,400 gross leasable area
Hotel	199 rooms
Day Care	13,200 gross square feet
Parking	975 spaces

It is of note that the Master Plan Design includes a 34% reduction in office space from the "worst case" development scenario presented in the DEIR, the 19 Story Office Buildings, presented in the DEIR. Significantly fewer person trips are generated by reducing the office space by one third. Total person trips are reduced by 295 trips (16%) in the morning peak hour and 957 trips (36%) in the evening peak hour from the 19 Story Office Buildings alternative.

Person trips generated by the Master Plan Design are set forth in Table II A-10 and are illustrated in Figure II A-10. The Master Plan Design will generate 13,632 total weekday person trips. Office space accounts for almost one-half the total daily trips. Office space is the primary generator of the 1,553 total person trips that will be made in the morning peak hour, and the 1,685 total person trips that will be made in the evening peak hour.

Table II A-11 and Figure II A-11 show vehicular trip generation for each time period. Almost 4,300 total daily weekday vehicle trips will be generated by the Master Plan Design. In the morning peak

Figure II A-10 Person Trips by Land Use



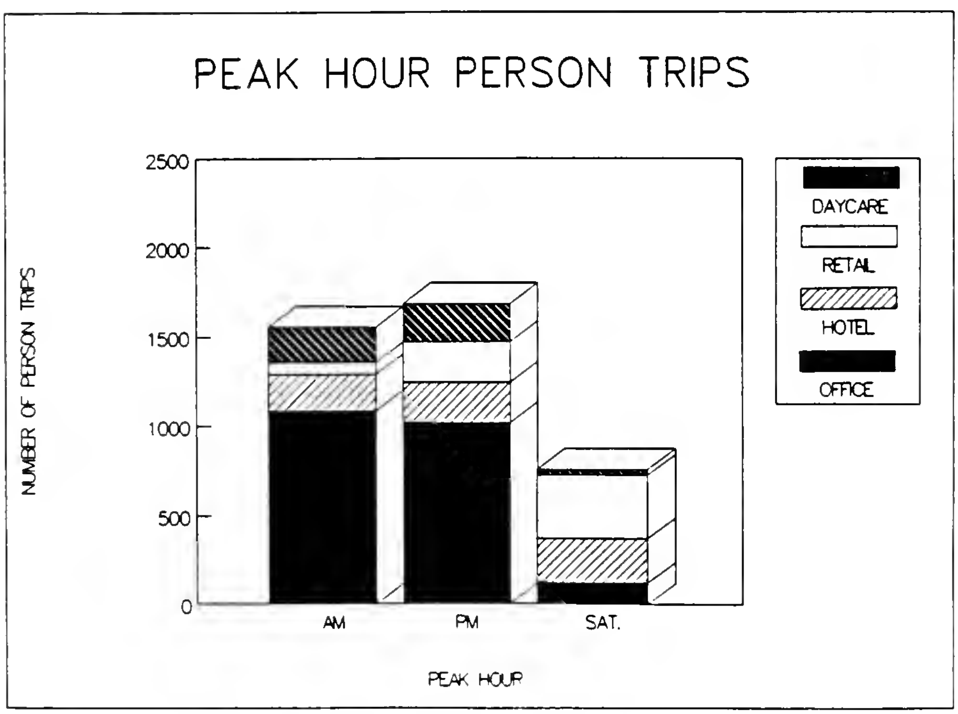


Table II A-10
Person Trip Summary: Master Plan Design

PERSON TRIP RATES:	TRIP RATES LAND USES: OFFICE	RETAIL	HOTEL	DAY CARE	TOTAL TRIPS BY USE: OFFICE	RETAIL	HOTEL	DAY CARE	TOTAL
Unit	000gsf*	000gla*	rooms	000 sf*	508.87	34.40	199	13.20	
TOTAL ADT*:									
Work	7.99	9.85	2.55	8.84	4,066	339	507	117	**5,029**
Non-Work	4.30	72.27	14.46	79.60	2,188	2,486	2,878	1,051	**8,603**
Total	12.29	82.12	17.01	88.44	6,254	2,825	3,385	1,168	**13,632**
AM PEAK									
In									
Work	1.48	0.80	0.07	0.80	753	28	14	11	**806**
Non-Work	0.37	0.54	0.61	7.15	188	19	121	94	**422**
Total In:	1.85	1.34	0.68	7.95	941	47	135	105	**1,228**
Out									
Work	0.00	0.00	0.00	0.71	0	0	0	9	**9**
Non-work	0.28	0.57	0.35	6.34	142	20	70	84	**316**
Total Out:	0.28	0.57	0.35	7.05	142	20	70	93	**325**
Total									
Work	1.48	0.80	0.07	1.51	753	28	14	20	**815**
Non-work	0.65	1.11	0.96	13.49	330	39	191	178	**738**
Total	2.13	1.91	1.03	15.00	1,083	67	205	198	**1,553**
PM PEAK									
In									
Work	0.11	0.62	0.00	0.78	56	21	0	10	**87**
Non-work	0.21	2.46	0.62	7.01	107	85	123	93	**408**
Total In	0.32	3.08	0.62	7.79	163	106	123	103	**495**
Out									
Work	1.43	0.69	0.04	0.84	728	24	8	11	**771**
Non-work	0.25	2.78	0.48	7.60	127	96	96	100	**419**
Total Out	1.68	3.47	0.52	8.44	855	120	104	111	**1,190**
Total									
Work	1.54	1.31	0.04	1.62	784	45	8	21	**858**
Non-work	0.46	5.24	1.10	14.61	234	181	219	193	**827**
Total	2.00	6.55	1.14	16.23	1,018	226	227	214	**1,685**

TABLE II A-10 continued

SATURDAY TOTAL									
Work	2.17	13.03	2.10	6.29	1,104	448	418	83	2,053
Non-Work	0.24	95.53	11.91	2.09	122	3,286	2,370	28	5,806
Total	2.41	108.56	14.01	8.38	1,226	3,734	2,788	111	7,859
SATURDAY PEAK									
In									
Work	0.12	0.26	0.00	1.07	61	9	0	14	84
Non-work	0.01	5.00	0.71	0.36	5	172	141	5	323
Total In	0.13	5.26	0.71	1.43	66	181	141	19	407
Out									
Work	0.10	0.25	0.04	0.65	51	9	8	9	77
Non-work	0.01	4.80	0.51	0.22	5	165	101	3	274
Total Out	0.11	5.05	0.55	0.87	56	174	109	12	351
Total									
Work	0.22	0.51	0.04	1.72	112	18	8	23	161
Non-work	0.02	9.80	1.22	0.58	10	337	242	8	597
Total	0.24	10.31	1.26	2.30	122	355	250	31	758

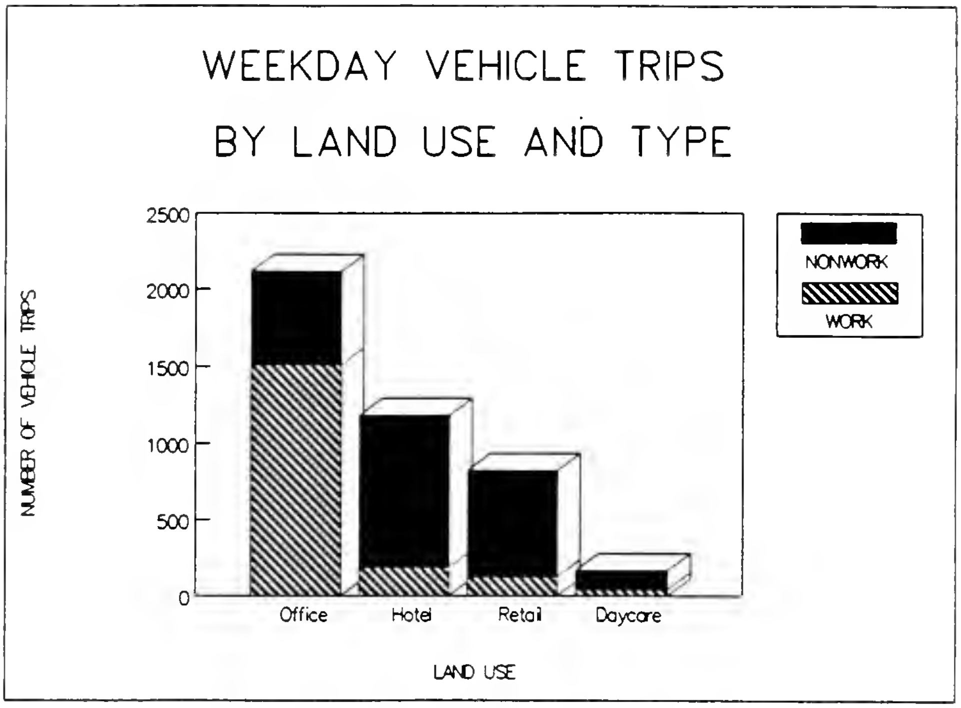
* ADT = Average Daily Traffic
* 000gsf = gross square footage in thousands
* 000gla = gross leasable area in thousands
* 000 sf = square feet in thousands

Table II A-11
Vehicle Trip Summary by Land Use and Type
Ruggles Center - Master Plan Design

	Office	Retail	Hotel	Daycare	Total
TOTAL ADT*					
Work	1,508	126	188	43	1,866
Non-Work	611	694	987	122	2,414
Total	2,119	820	1,175	166	4,279
AM PEAK					
In					
Work	279	10	5	4	299
Non-Work	52	5	42	11	110
Total In	332	16	47	15	409
Out					
Work	0	0	0	3	3
Non-work	40	6	24	10	79
Total Out	40	6	24	13	82
Total					
Work	279	10	5	7	302
Non-work	92	11	66	21	189
Total	371	21	71	28	492
PM PEAK					
In					
Work	21	8	0	4	32
Non-work	30	24	42	11	107
Total In	51	32	42	15	139
Out					
Work	270	9	3	4	286
Non-work	35	27	33	12	107
Total Out	306	36	36	16	393
Total					
Work	291	17	3	8	318
Non-work	65	51	75	22	214
Total	356	67	78	30	532
SATURDAY TOTAL					
Work	410	166	155	31	762
Non-Work	34	917	813	3	1,767
Total	444	1,083	968	34	2,529
SATURDAY PEAK					
In					
Work	23	3	0	5	31
Non-work	1	48	48	1	98
Total In	24	51	48	6	130
Out					
Work	19	3	3	3	29
Non-work	1	46	35	0	82
Total Out	20	49	38	4	111
Total					
Work	42	7	3	9	60
Non-work	3	94	83	1	181
Total	44	101	86	9	241

*ADT = Average Daily Traffic

Figure II A-11 Vehicle Trips by Land Use



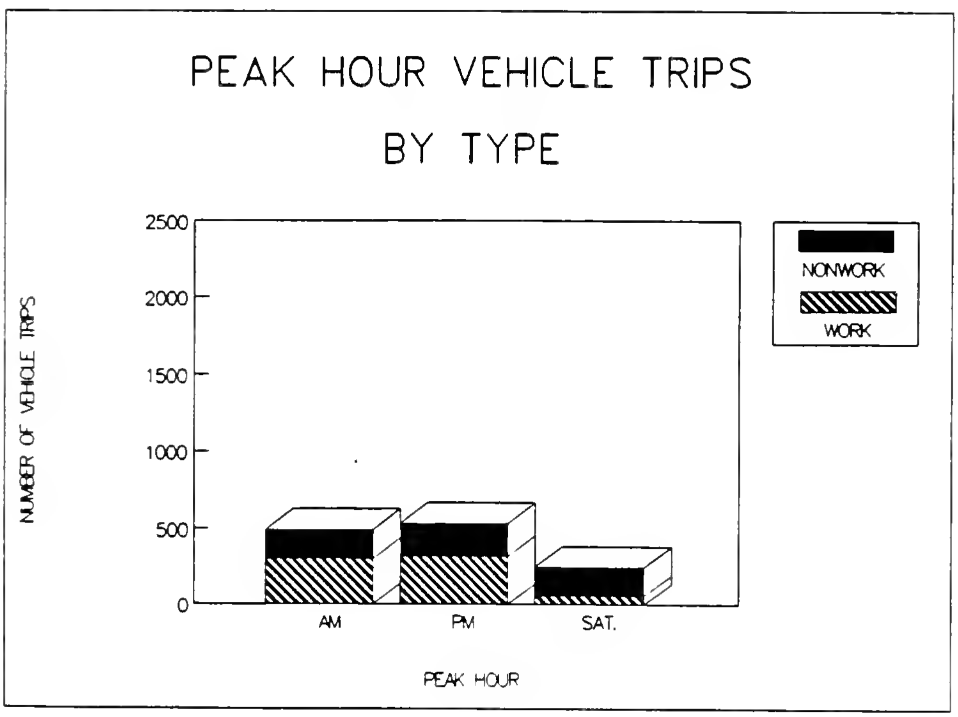


Table II A-12

Directional Distribution of Ruggles Center Vehicle Trips

Compass Direction	General Distribution	Local Area Component	Regional Component
North	25 %	7.5 %	17.5 %
South	35	10.5	24.5
East	10	10.0	–
West	30	9.0	21.0
	100 %	37.0 %	63.0 %

Table II A-13

Proportional Assignment of Ruggles Center Trips to Major Streets

	LOCAL TRIPS				REGIONAL TRIPS				ROUNDED DISTRIBUTION
	N	S	E	W	N	S	E	W	(% Trips Generated)
Melnea Cass Blvd.	-	-	.4	-	.8	.8	-	.6	50
Columbus Ave.	.4	-	-	-	.1	-	-	.2	10
Tremont St.(N)	.2	-	-	-	.1	-	-	.1	5
Tremont St.(S)	-	.6	.6	.3	-	.2	-	-	20
Ruggles St.(W)	.4	.4	-	.7	-	-	-	.1	15
									100%

hour, almost 500 vehicle trips will be made, and in the evening peak hour 532 vehicle trips are estimated.

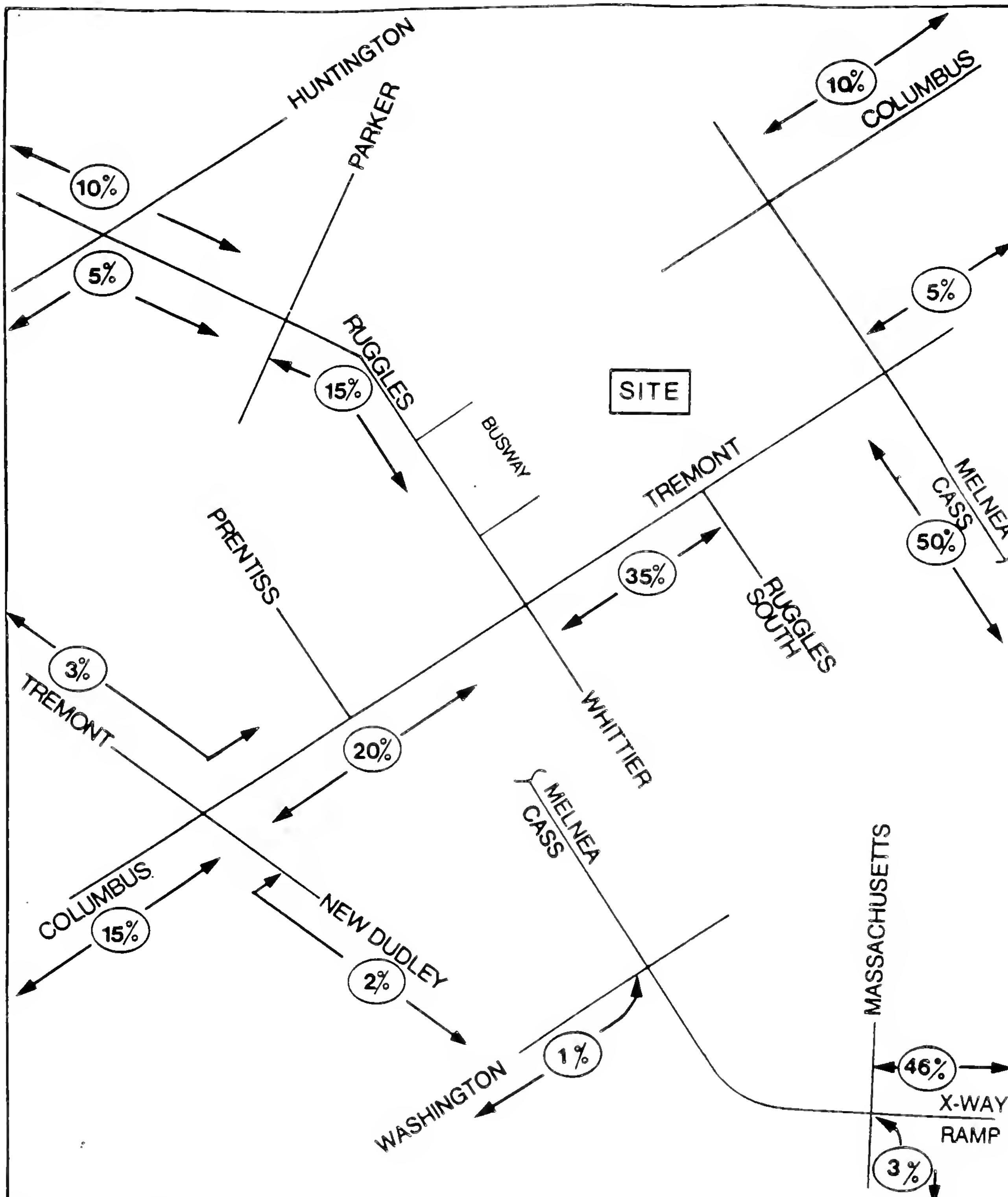
Vehicle Trip Distribution

In order to show the impacts of the Master Plan Design on the street system, it is necessary to distribute the vehicle trips generated into the directions of origin/destination, and to assign such directional division of trips to the actual roadways serving the development. Such assigned volumes when added to the existing and background growth traffic form the input for calculation of estimated Levels-of-Service (LOS) when Ruggles Center is built.

For Ruggles Center the regional directional distribution of trips was slightly adapted for specific aspects of the development. Regional distributions of central Boston-generated vehicle trips have shown a roughly equal division into the three general compass directions available, North, West, and South, with often the greatest bias towards the South, then West, and lastly, the North. Such a distribution has been used in many Environmental Impact Reports and other studies, and have varied somewhat according to the defined composition of each directional corridor and the orientation of the project being considered. A recent Howard/Stein-Hudson Associates study (1988) of the origins and destinations of persons parking in the Lafayette Place area of Downtown Boston bears out this general assumption.

The directional distribution of vehicle trips shown in Table II A-12 is considered likely for Ruggles Center. The East direction has been introduced to recognize the easterly trips that will come from Roxbury and North Dorchester for this project. A prorating into the general local area and the rest of the region was done on a 30% local and 70% regional basis, except to the East, which was retained as primarily local, resulting in the 37% and 63% numbers shown. The above reference shows that for a Downtown Boston location, almost 20% of trips come from the surrounding urban core area. Since Ruggles Center is intended to have a significant local area community orientation, a higher value of 30% was assumed.

To assign the above distribution to the actual street network serving the project, judgments were made on what proportions of local and regional trips would travel on specific streets. The major streets serving the project are shown in Table II A-13. This table shows the strong orientation of vehicle trips to Melnea Cass Boulevard (50%), reflecting its direct routing to the expressway system -- Southeast



HOWARD/STEIN-HUDSON ASSOCIATES

Percentage Distribution of Master

Plan Design Vehicle Trips

N

Figure II A-12

Expressway, Central Artery and Massachusetts Turnpike. Given the scale of the development as both a regional and community oriented project, it is not surprising to see one-half of the trips coming directly from major roadways. Tremont Street (S), just north of Roxbury Crossing, has the next highest percentage (20%), as it collects traffic to and from the south coming from Tremont towards Brigham Circle, Columbus Avenue towards Centre, Seaver and Washington Streets, and from New Dudley Street towards Dudley Square and beyond. A more complete presentation of the assignment to all study area intersections is shown by proportion in Figure II A- 12.

Public Transportation Trip Distribution

Determination of the public transportation system impacts of the 1996 No Build background development and the Master Plan Design alternative was carried out as follows. First, public transportation trips were estimated for the background development and the build alternative based on the appropriate modal split percentages for each land use described above. These trips were then distributed to the transit and bus lines serving the site based upon the employment catchment area served by each line. The resulting distribution was the following:

- 35% — Orange Line North (most direct access to downtown Boston, connecting to the central subway system and commuter rail at North Station);
- 20% — Orange Line South (southwest corridor, some feeder bus access to southerly stations);
- 2% — Green Line West (to Brigham Circle);
- 10% — Green Line East (via Huntington Ave. to Kenmore Sq., Back Bay, Central Subway);
- 30% — Bus Routes (only public transportation access to large southwest corridor employment market); and,
- 3% — Commuter Rail (from South Station and Southwest).

The resultant passenger volumes were then applied to the time periods under study to determine analysis volumes for the back-

ground development and the Master Plan Design, as explained further in the next section.

Master Plan Design Impacts

No Build Traffic Forecast

Forecasts of future traffic in the study area must take into account two types of growth: 1) increased traffic that occurs because of development in or near the study area itself, and 2) background growth, or growth in traffic through the area (i.e, without a destination in the study area). The No Build traffic forecasts for the study area incorporate both normal (background) growth plus all development that is planned for the study area by the 1996 analysis year. This serves as the baseline against which to evaluate the Master Plan Design for Ruggles Center.

To estimate the No Build traffic forecast, the two components of growth were estimated separately and then combined to achieve a single growth factor. This factor was then applied to the 1988 peak hour traffic volumes measured at study key intersections.

Local Traffic within Study Area

In order to determine the base against which traffic growth can be measured, 1985 population and employment data for the study area were established from data collected by the Central Transportation Planning Staff (CTPS) for traffic zones contiguous to Ruggles Center, as shown in Figure II A-13.

New Traffic Generators

To estimate the new traffic resulting from these projects, population and employment factors were assessed as shown in Table II A-14.

Table II A-14
Population and Employment Factors

Land Use Type	Unit of Measurement	Person/Unit
Hospital/Dormitory	Beds	1
Housing	Units	3
Office Space	1,000 sf.	4.5
Retail Space	1,000 sf.	2

Utilizing these factors, an estimate of the number of new persons that would be added to the 1985 daily population in the study area as a result of these projects was made.

The development occurring between 1985-1988 was first inventoried. Since there was virtually no new development during this time period, the 1985 figures were considered valid as a representation of 1988. Using the factors above, new employees and residents were then estimated for the period from 1988 to 1996. The calculation indicates that this new group of persons represents an increase of 25.9% to the 1988 population residing or employed in the area as defined (or 3.23% per year on average over eight years).

Table II A-15 lists development projects in the study area scheduled for completion from 1985-1996 and estimates the size of each project by land use, as obtained from the Boston Redevelopment Authority. The table is keyed to Figure II A-13.

Local versus Through Traffic Growth

In order to translate this increased population into a the No Build traffic forecast, it was then necessary to determine how much of the traffic actually counted at study area intersections was locally generated. No survey data are currently available for the study area which measure the mix of local and through traffic. However, 1987 survey data are available for the adjacent Longwood Medical Area. Local traffic represents about 35% of total traffic in the Longwood area. Although considered a conservative assumption for the Ruggles Center study area, where no major generators exist today, the same share of local traffic was applied. This may result in a slight overstatement of growth in local traffic.

Assuming that the proposed developments increase local traffic generation by 25.9% and existing local traffic is 35% of total traffic, then the overall impact of these development projects other than Ruggles Center is to increase total traffic by 9.1% from 1988-1996 due to local traffic; i.e.,

(3.23% x 8 years) x (35% local traffic) = 9.1% traffic growth.

Comparable traffic counts (at the same intersections and at the same time of year) from 1986 and 1988 were used to help identify general traffic growth. Comparisons of total peak hour approach volumes at four key intersections are listed in Table II A-16.

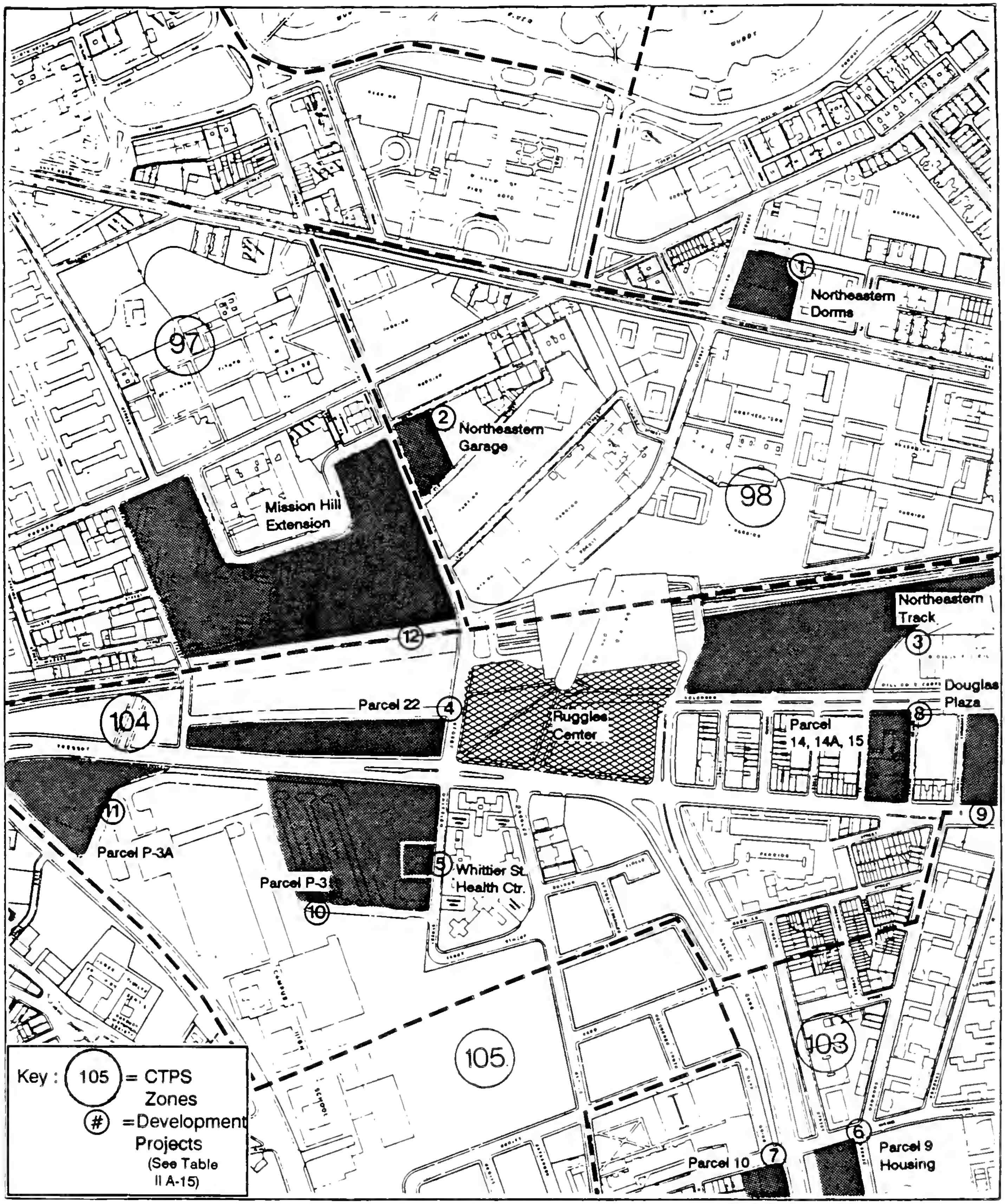


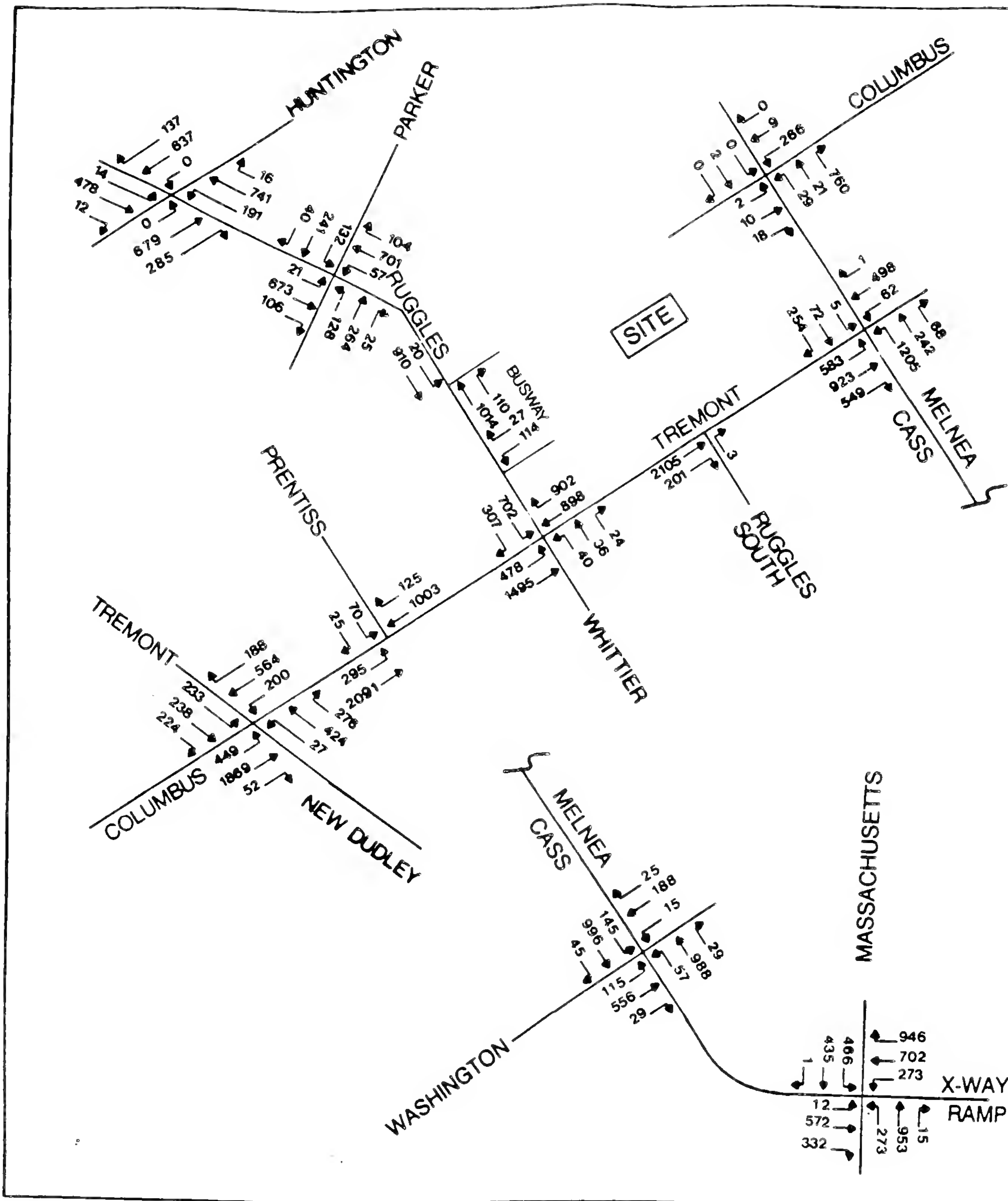
Figure II A-13
Design Year (1993) Background Development

Table II A-15
Ruggles Center Design Year (1996) Background Development Projects

Map No.	CTPS Zone	Project	Year Completed	Office (Sq.Ft.)	Retail (Sq. Ft.)	Housing (D.U.)	Other	Parking Spaces
1	98	Northeastern Dorms	1993				550 beds	
2	98	Northeastern Garage	1993					500
3	98	Northeastern Track	1993				180,000	
4	104	Parcel 22	1994		3,000	200		266
5	104	Whittier St. Health Ctr.	1996	25,000				
6	103	Parcel 9 Housing	1995			83		62
7	103	Parcel 10 - Mixed Use	1995		10,000	124		121
8	104	Parcels 14,14A, 15	1994		80	80		74
*		80 Dudley Street (Boys and Girls Club)	1992	26,000	2,000			100
9	104	Douglas Plaza Phase I	1990		6,550	164		146
		Phase 2	1994		10,000	100		100
10	104	Parcel P-3 (Afro-American Center)	1994	629,000	31,000			430
11	104	Parcel P-3A	1995				60,000	108
*		Roxbury Community College	1995	63,000			172,000	320
12		Mission Hill Extension	1992			450	10,000	225
*		Roxbury Crossing	1989			22		22
*	105	Parcel P2C - Post Office	1992				39,400	150
		Total (in sq. ft.)		743,000	62,630	1,223	461,400 550 beds	2,624

* not shown on map

Source: Boston Redevelopment Authority



HOWARD/STEIN-HUDSON ASSOCIATES

No Build (1996) Traffic Volumes: AM Peak Hour

N

Figure II A-14

Table II A-16
Study Area Traffic Growth, 1986 - 1988

Peak Hour	Total Approach Volume At Key Intersections* 1986	1988	% Increase
Weekday:			
AM	16,688	15,204	- 8.9
PM	17,667	16,912	- 4.3
Saturday:			
PM	12,331	13,487	+ 9.4

* Huntington/Ruggles, Tremont/Columbus/New Dudley, Tremont/Ruggles/Whittier, Tremont/Melnea Cass

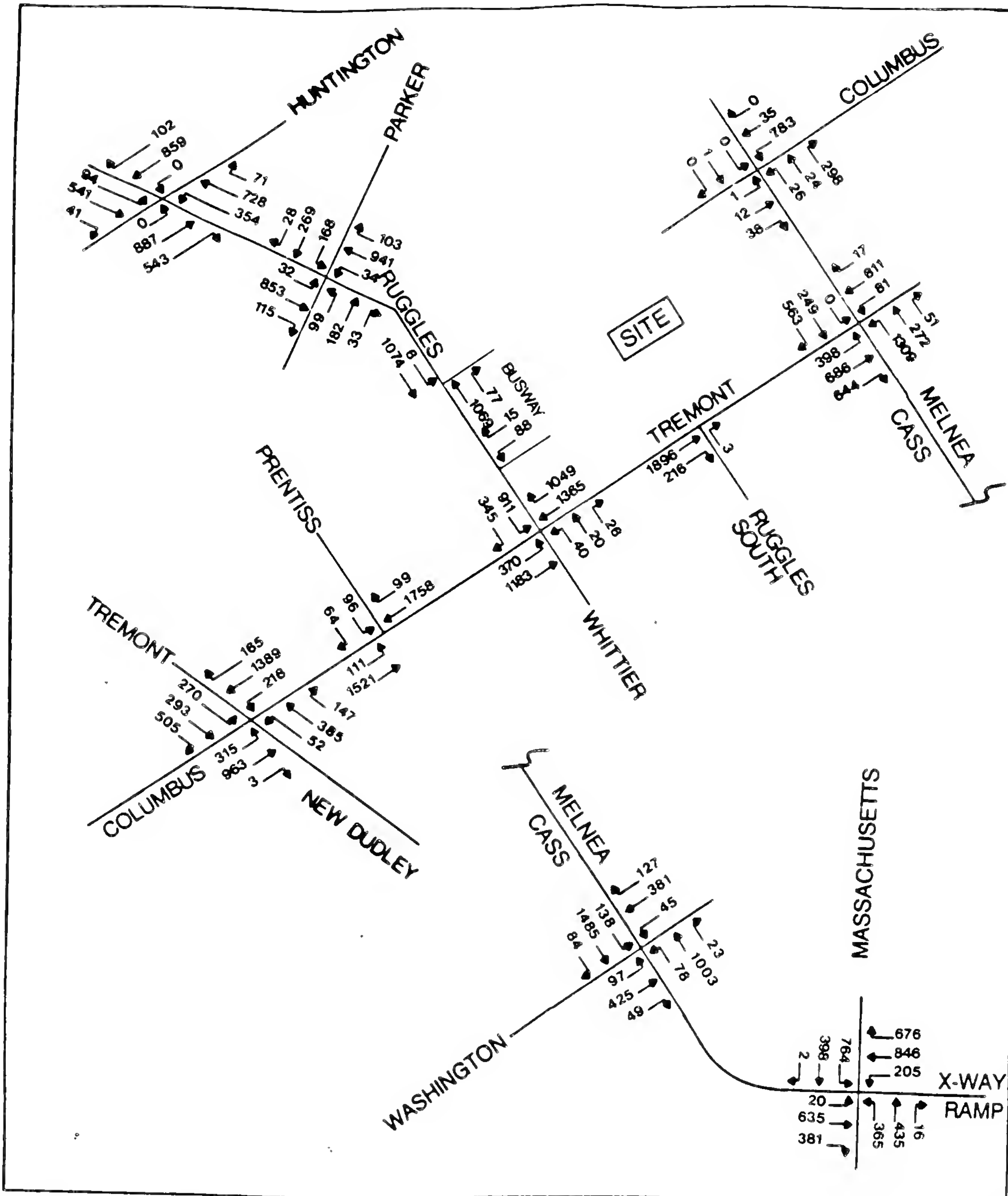
Interestingly, the 1986 counts were generally higher than those in 1988, except during the Saturday peak hour. It is possible that the opening of the relocated Orange Line in 1987 caused a reduction or at least a stabilization of vehicular traffic in the corridor between 1986 and 1988. It is reasonable in forecasting the future, however, to expect a return to more normal patterns of slow, but increasing growth in through traffic. For this reason, an annual growth rate of 1% was assumed for forecast period of 1988-1996. This rate was applied to the through traffic component (65% of total traffic) as follows (through traffic growth from 1988-1996 due to local traffic); i.e.,

(1% x 8 years) x (65% through traffic) = 5.2% .

Total No Build Traffic Growth

Combining the locally generated component of total traffic growth within the study area (9.1%) and the through traffic component (5.2%) yields a traffic increase of approximately 14.3% over the 1988 existing traffic volumes for the 1996 analysis year, or about a 1.75% annual growth rate from 1988-1996. Figures II A-14, II A-15, and II A-16 show forecast peak hour traffic study area intersections.

The assumption of a 1.75% annual growth rate in the study area for the period 1988-1996 is conservative when compared to the growth rate for regional traffic incorporated in the Central Artery/Third

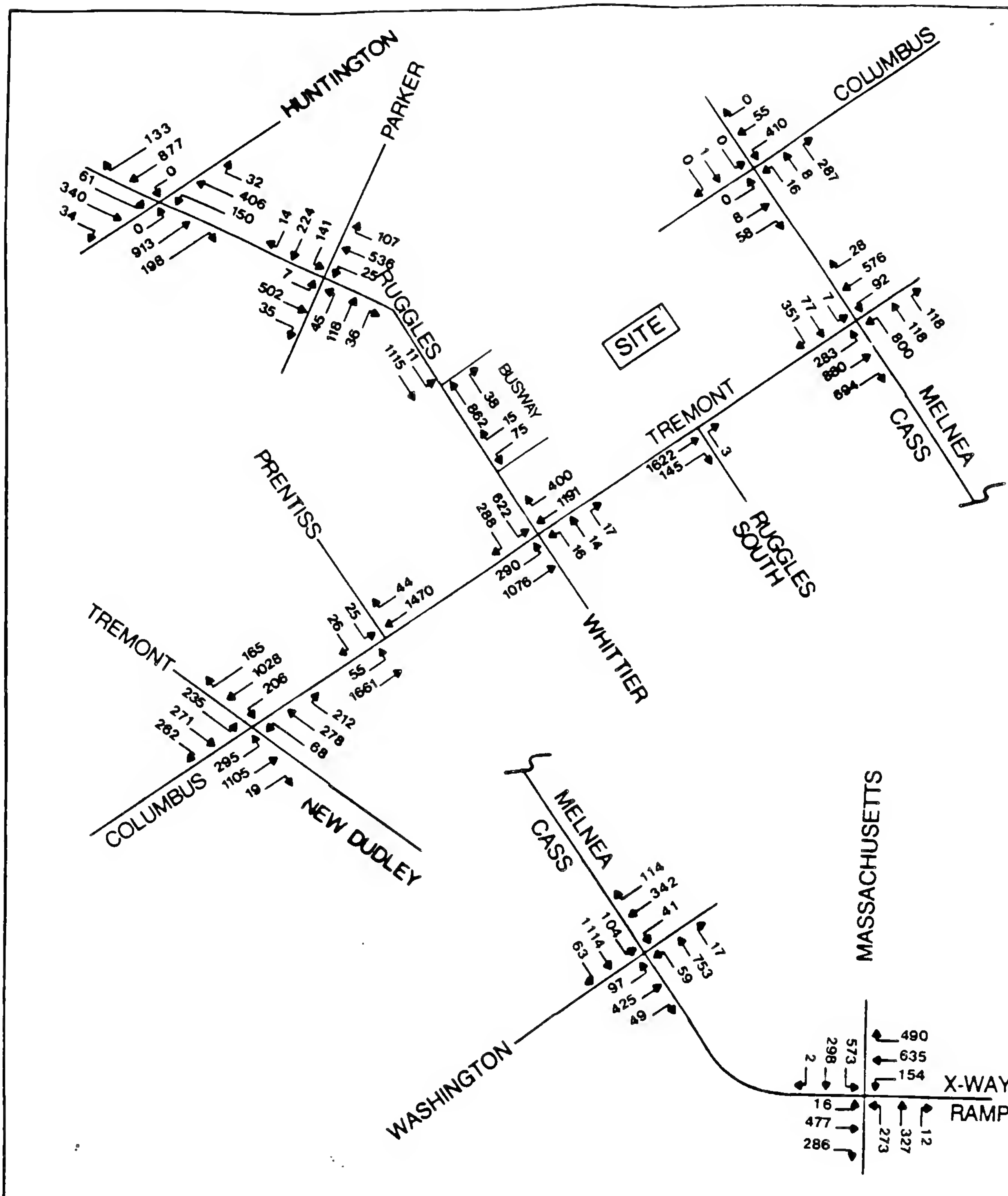


HOWARD/STEIN-HUDSON ASSOCIATES

No Build (1996) Traffic Volumes: PM Peak Hour

N

Figure II A-15



HOWARD/STEIN-HUDSON ASSOCIATES

No-Build (1998) Traffic Volumes:

Saturday PM Peak Hour

N

Figure II A-16

Harbor Tunnel SFEIS by the Massachusetts Department of Public Works (MDPW). For the region, the MDPW projects traffic growth of less than 1% per year (0.8%) from 1987-2010 for the baseline case (without the Central Artery/Third Harbor Tunnel project). At the nearest screen line location (Columbus Avenue north of Massachusetts Avenue), the growth rate for the baseline case is 2.0% per year for northbound traffic and 1.1% per year for southbound traffic. It should be noted that the MDPW projections includes the Ruggles Center development, as well as the other identified background developments.

Proposals for Roadway Network Changes

In addition to traffic growth, long-term changes in the study area roadway network need to be taken into account in order to accurately predict the impacts of the No Build traffic growth and the traffic generated by the Ruggles Center project. For the 1996 analysis year, the following roadway network assumptions along the Tremont Street and Ruggles Street corridors and at the Melnea Cass/Washington intersection are incorporated in the assessment of future traffic volume levels and operating conditions.

Tremont Street Corridor

As previously mentioned, since the traffic operations analysis contained in the DEIR was completed, pavement restriping along the Tremont Street corridor from New Dudley Street to Ruggles Street has provided for the use of the breakdown lane as a travel lane. This change has effectively increased the number of lanes in use along this portion of Tremont Street from 2 to 3 in both directions. All traffic operations analysis in this report (Existing, No Build and Build) reflect this change.

Ruggles Street Corridor

The MBTA in conjunction with the City of Boston is in the process of designing and implementing improvements to the Ruggles Street corridor from Huntington Avenue to Tremont Street. The proposed improvements include widening and improving Ruggles Street to two lanes in each direction between the Ruggles Station and Huntington Avenue and improvements to the MBTA Busway and to the Tremont/Ruggles/Whittier intersection to facilitate bus turning movements. The Master Plan Design site plan reflects these proposed improvements including the land necessary to increase the turning radius along the southbound Tremont Street approach to Ruggles Street.

Melnea Cass/

The Melnea Cass Boulevard/Washington Street intersection is included in the MBTA's Washington Street Replacement Service Study.

Washington / Intersection

Although the Replacement study is incomplete, it is evident from the existing intersection geometry at this location that improvements will be necessary since the elimination of the overhead track structure of the former Orange Line. In addition, the high volume of eastbound Melnea Cass Boulevard traffic which currently executes prohibited left turns during the peak hour period indicates a need for improvements at this location, specifically in terms of left turn storage lanes on Melnea Cass Boulevard.

Traffic Impacts

As listed in Table II A-11, trips generated by the land uses associated with the Master Plan Design are estimated at 409 vehicle trips inbound and 82 vehicle trips outbound during the morning peak hour period. During the evening peak hour, 140 vehicles are estimated to enter the site with 394 vehicles exiting the site. The volume of traffic generated during the Saturday peak hour period is more evenly divided between entering and exiting traffic at 133 vehicles inbound and about 114 vehicles outbound.

Traffic generated by the Master Plan Design is able to disperse quickly into several directions along study area roadways and is also able to utilize more than one lane at most intersection approaches. As an overview to the relative contributions of existing, No Build (other projects plus background traffic growth), and Master Plan Design traffic volumes to the traffic impacts, the total approach volumes at some key intersections for the evening peak hour are shown in Figure II A-17 as a bar chart divided into the three components. The traffic volume data incorporated into the bar chart assumes a single entrance/exit to Ruggles Center at the Melnea Cass/Columbus intersection (Access Option 1).

Although the bar chart does not differentiate between different intersection movements (which vary as to the number of lanes available and whether a given movement is critical) the relative volume contribution to the total intersection is a reasonable indicator of the relative impact of each volume source. It can be seen in most cases that the cumulative impact of the No Build traffic generated by planned background developments is far greater than Master Plan Design generated traffic, and that both of these are moderately small in reference to existing traffic volume levels. It takes approximately 150 vehicles per hour per lane in the critical movements of an intersection to cause one full level of service change.

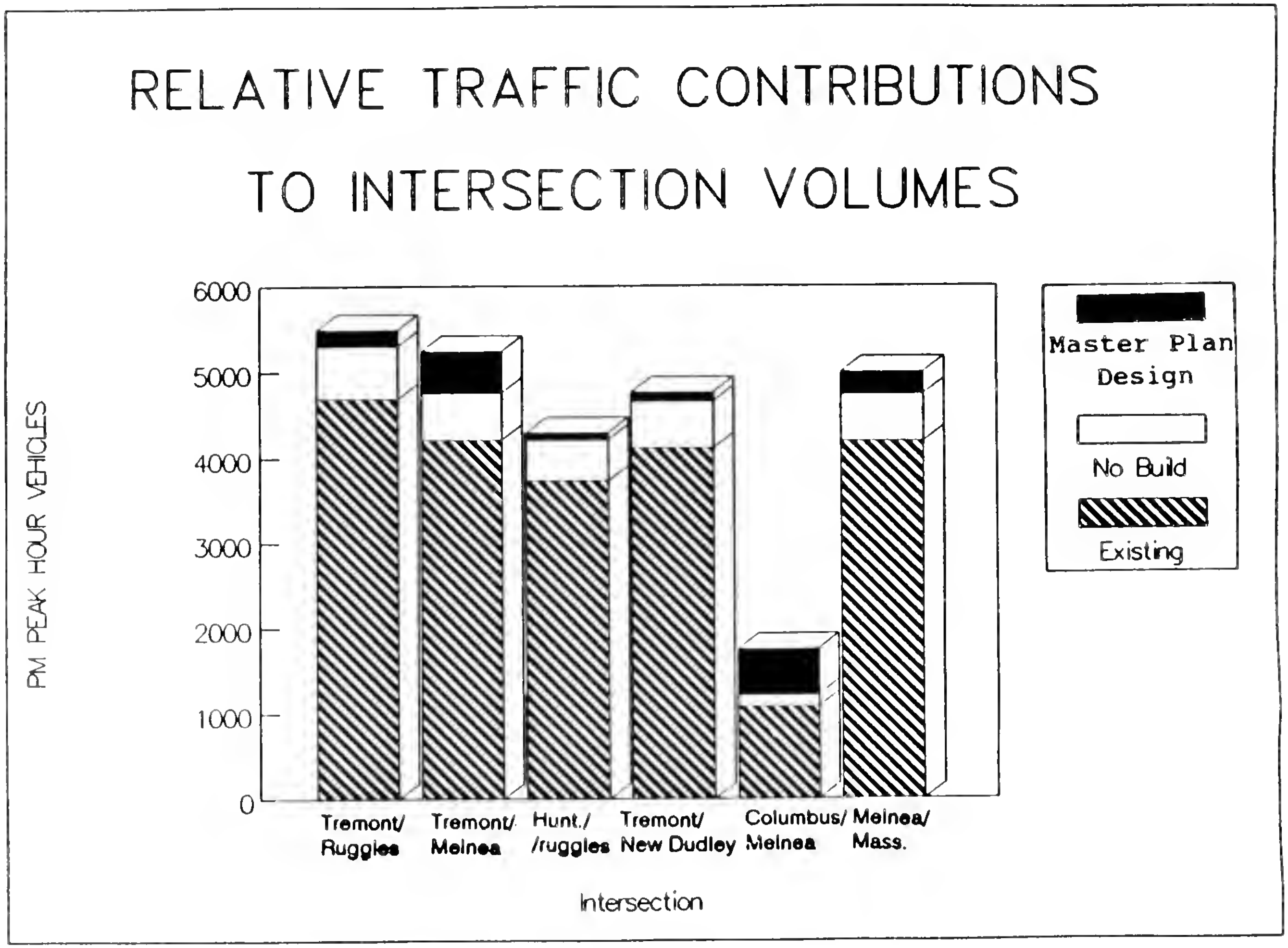


Figure II A-17:
Relative Contributions of Existing, No-Build and Project Alternative Traffic to Intersection Volumes

No Build Alternative

The No Build level-of-service analysis, described in the following sections, is graphically summarized for existing conditions on Figures II A-24, II A-25, and II A-26. These figures are presented at the end of this traffic impacts section.

Table II A-17 presents the expected traffic operations for the No Build (1996) conditions, assuming the roadway improvements previously identified are not yet completed (with the exception of restriping and lane usage along Tremont Street between New Dudley and Ruggles Street). As expected, because of the overall 14 percent traffic growth from 1988 to 1996, average delays at all intersection locations increase under No Build conditions, compared to the existing conditions.

During the morning peak hour period, most intersection locations operate at acceptable levels of service, with Melnea Cass/Massachusetts/Southampton/X-Way Ramps at LOS D. Locations exhibiting deficient traffic operating conditions include the intersections of Tremont/Melnea Cass (LOS E) and Parker/Ruggles (LOS F).

Deficient traffic operating conditions occur at three intersection locations during the evening peak hour period all of which operate at LOS F with delays ranging from 2 to 5 minutes: Tremont/Melnea Cass, Huntington/Ruggles, and Parker/Ruggles. The remaining intersections in the study area operate at acceptable conditions during the evening peak hour period, including the intersections of Tremont/Ruggles/Whittier and Tremont/Columbus/New Dudley which operate at LOS D. All intersection locations operate at acceptable levels during the Saturday peak hour period, with Tremont/Melnea Cass at LOS D.

For the No Build analysis year, poor traffic operations within the study area generally occur along the Ruggles Street corridor at Huntington Avenue and Parker Street and at the intersection of Tremont Street and Melnea Cass Boulevard. In order to accurately estimate the impacts of Ruggles Center generated traffic, the degradation of traffic operations at study area intersections for No Build conditions is assumed to be improved to LOS D or above prior to the addition of project vehicle trips. Responsibility for these mitigation measures will be discussed later in this report.

Table II A-17
No Build (1996) Conditions - Traffic Operations Summary Without Improvements

SIGNALIZED INTERSECTIONS

Intersection Location	AM PEAK HOUR LOS	AM PEAK HOUR Average* Delay	PM PEAK HOUR LOS	PM PEAK HOUR Average Delay	SAT PEAK HOUR LOS	SAT PEAK HOUR Average Delay
Tremont/Ruggles/Whittier	C	20	D	36	B	14
Tremont/Melnea Cass	E	44	F	134	D	27
Ruggles/Busway	A	5	A	4	A	3
Tremont/Prentiss	A	5	B	6	A	2
Huntington/Ruggles	C	17	F	189	B	13
Tremont/Columbus/New Dudley	C	21	D	33	C	20
Parker/Ruggles	F	133	F	297	C	21
Melnea Cass/Columbus/Bus Drive	A	3	A	4	A	5
Melnea Cass/Washington	C	23	C	16	B	12
Melnea Cass/Massachusetts/ Southampton/Expressway Ramps	D	26	C	25	C	20

* in seconds

No Build Traffic with Proposed Roadway Changes

No Build traffic operations with the assumed roadway improvements along the Ruggles Street corridor at Huntington Avenue and Parker Street, and the proposed improvements at Tremont/Melnea Cass and Melnea Cass/Washington intersections are presented in Table II A- 18, and discussed in the sections below.

Ruggles Street Corridor

Roadway improvements previously identified along the Ruggles Street corridor are expected to improve No Build traffic operations to acceptable levels at the Ruggles Street intersections with Huntington Avenue and Parker Street. In addition, proposed changes along this corridor are expected to improve bus operations at the intersections of Ruggles Street with the Ruggles Station Busway and at Tremont and Whittier Streets. These roadway improvements are expected to be undertaken during the widening of Ruggles Street currently under design by MBTA and proposed for Urban Systems funding. The following identifies the geometry and lane requirements as identified in the No Build analysis.

Roadway improvements at the Huntington/Ruggles intersection should provide for:

- designated right turn lane along the northbound Huntington Avenue approach;

- one left turn lane and one multi-purpose lane along the westbound Ruggles Street approach;

- two multi-purpose lanes provided along the eastbound Louis Prang approach coupled with a peak hour eastbound left turn prohibition; and

- improved signage and enforcement of existing left turn prohibitions along both Huntington Avenue approaches.

Under these improved roadway conditions, this intersection would operate at acceptable levels (LOS B, C, B) under No Build conditions during the morning, evening and Saturday peak hour periods, respectively.

Roadway improvements at the Ruggles/Parker intersection should provide for:

Table II A-18

No Build (1996) Conditions
Traffic Operations Summary With Improvements by Others

	SIGNALIZED INTERSECTIONS					
	AM PEAK HOUR Average		PM PEAK HOUR Average		SAT PEAK HOUR Average	
Intersection Location	LOS	Delay	LOS	Delay	LOS	Delay
Tremont/Melnea Cass	C	23	D	37	C	17
Huntington/Ruggles	B	15	C	22	B	12
Parker/Ruggles	C	18	C	22	B	14
Melnea Cass/Washington	B	13	B	14	B	11

- two multi-purpose lanes along both Ruggles Street approaches;

- one multi-purpose lane along both Parker Street approaches.

No Build traffic operations at the Ruggles/Parker intersection are expected to improve to acceptable levels (LOS C, C, B) during the morning, evening and Saturday peak hour periods, respectively, with these improvements.

Tremont/Melnea Cass Intersection

Intersection improvements at the Tremont/Melnea Cass location are also necessary under No Build conditions to improve traffic operations to acceptable levels. At the present time, there are no plans or proposed improvements in the design stage at this location, although several discussions have taken place since the DEIR between the developer and the City of Boston, and the MBTA's traffic consultants about alternative improvement measures.

Improvements required at the Tremont/Melnea Cass intersection to bring traffic operations to acceptable levels include:

- widen the northbound Tremont Street approach from three to four lanes (consisting of one left turn lane, two through lanes and one right turn lane);

- increase the southbound Tremont Street approach from two to three lanes by pavement restriping (including one left turn lane, one through lane and one multipurpose lane); and

- widen the eastbound Melnea Cass approach from two to three lanes by restriping and possibly minor physical widening (providing for one through/left turn lane, one through/right lane and one right turn lane).

These intersection improvements can improve traffic operations to acceptable levels for No Build traffic conditions during all peak hour periods: LOS C for morning, LOS D for evening and and LOS C for Saturday. It should be noted that additional improvements are suggested at this location under Build conditions.

Melnea Cass/ Washington Intersection

Although traffic operations are at acceptable levels at the intersection of Melnea Cass Boulevard and Washington Street, these conditions can be improved with enforcement of the existing peak hour eastbound left turn prohibitions. This mitigation is important in view of the added traffic anticipated at this location due to the Ruggles Center development. No Build traffic operations will improve to LOS B during all peak hour periods with improved signage and enforcement.

Master Plan Design

The proposed Ruggles Center development is expected to be completed in 1996. The land use elements of the Master Plan Design include office, retail, hotel and day care components (refer to Table II A-7). As requested in EOTC's comments to the DEIR, traffic operations for Build conditions have been analyzed for the following three vehicular access options:

- Access Option 1 (without Tremont access) - access from the Columbus/Melnea Cass intersection only;

- Access Option 2 (with Tremont right in/out) - access from the Columbus/Melnea Cass intersection and the provision for the right turns in and right turns out at Tremont Street and Ruggles Center Drive; and

- Access Option 3 (with Tremont access) - access from the Columbus/Melnea Cass intersection and access from Tremont Street, including right in/out and left turns in from Tremont northbound at the Ruggles Center Drive. Left turns out of the site driveway are prohibited.

The Master Plan Design traffic volume levels are presented in Figures II A-18, II A-19 and II A-20 for the morning, evening and Saturday peak hour periods, respectively. These traffic volumes reflect the assumptions identified for Access Option 1 (without Tremont access) where all vehicles enter and exit the site from a single entrance at the Melnea Cass Boulevard/Columbus Avenue intersection.

Intersections where traffic volumes are influenced by the alternative vehicular access options include: Melnea Cass/Columbus, Tremont/Melnea Cass and Tremont/Ruggles Center Site driveway.

Traffic volumes at all other study area intersections will not be influenced by any of the vehicular access options. Traffic volumes for Access Option 2 (with Tremont right in/out) and Access Option 3 (with Tremont access) are presented in Figures II A- 21 and II A-22, respectively.

Table II A-19 indicates the traffic operations for the Master Plan Design. Traffic operations are presented for each vehicular access option for the intersections that are affected by them; Tremont/Melnea Cass, Melnea Cass/Columbus and Tremont/Ruggles Center Drive. Again, for comparison purposes, the analysis assumes the roadway improvements identified as necessary to improve traffic operation deficiencies identified in the No Build traffic analysis have been implemented.

The analysis indicates that vehicular access options for the Ruggles Center development have significant implications on traffic operations at the Tremont/Melnea Cass intersection while having only minor implications on operations at the intersections of Melnea Cass/Columbus and Tremont/Ruggles Center Drive.

The analysis will show that acceptable traffic operations, in terms of LOS and queue length analysis, along Tremont Street adjacent to the site will involve the choice of Access Option 2 (right turns in/out only at Tremont/Ruggles Center Drive intersection) combined with additional improvements above those identified in the No Build analysis at the Tremont Street/Melnea Cass Boulevard intersection.

During the morning peak hour period, traffic operation impacts for the Master Plan Design remain within the same LOS designations as in the No Build conditions under proposed roadway improvements with the exception of:

- Tremont/Melnea Cass
  - without Tremont access (LOS C to E);
  - with Tremont right in/out (LOS C to E);
  - with Tremont access (LOS C to D);
- Tremont/Prentiss (LOS A to B);
- Melnea Cass/Columbus
  - all access options (LOS A to B); and

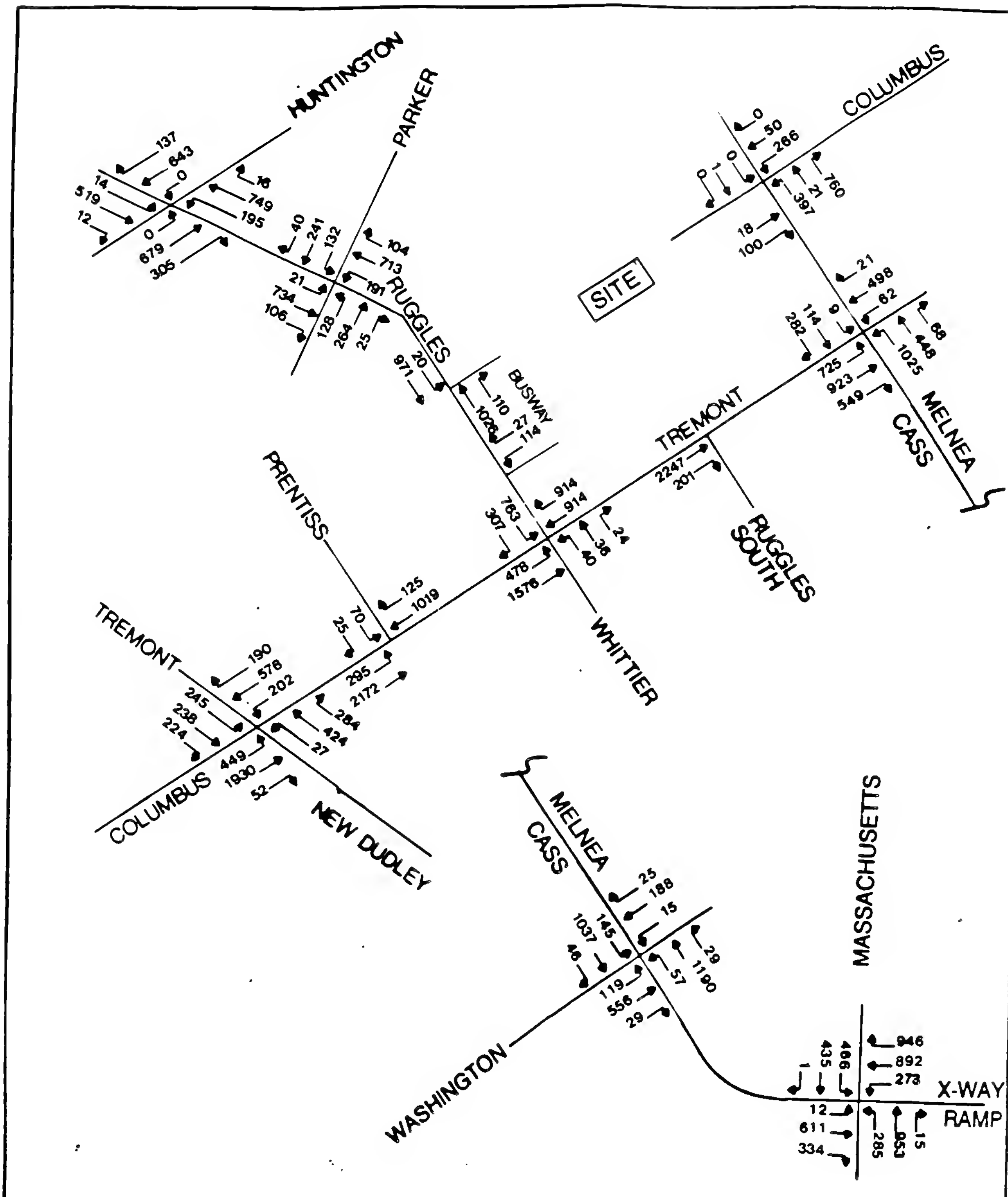
Table II A-19
Master Plan Design - Traffic Operations Summary

SIGNALIZED INTERSECTIONS

Intersection Location	AM PEAK HOUR LOS	AM PEAK HOUR Average Delay	PM PEAK HOUR LOS	PM PEAK HOUR Average Delay	SAT PEAK HOUR LOS	SAT PEAK HOUR Average Delay
Tremont/Ruggles/Whittier	C	22	E	48	B	14
Tremont/Melnea Cass						
- w/o Tremont access	E	51	F	84	C	18
- w/Tremont right in/out	E	50	E	50	C	15
- w/Tremont access	D	25	D	37	C	15
Ruggles/Busway	A	5	A	4	A	3
Tremont/Prentiss	B	6	B	6	A	2
Huntington/Ruggles	B	15	C	23	B	12
Tremont/Columbus/New Dudley	C	22	D	36	C	20
Parker/Ruggles	C	20	D	25	B	14
Melnea Cass/Columbus/Bus Drive						
- w/o Tremont access	B	10	C	18	B	13
- w/Tremont right in/out	B	9	B	14	B	11
- w/Tremont access	B	9	B	13	B	10
Melnea Cass/Washington	C	19	C	16	B	12
Melnea Cass/Massachusetts/ Southampton/X-Way Ramps	D	29	D	26	C	20
Tremont/Ruggles Center Drive						
- w/Tremont access	A	2	A	1	A	1

UNSIGNALIZED INTERSECTION

Intersection Location	AM PEAK HOUR LOS	AM PEAK HOUR Reserve Capacity	PM PEAK HOUR LOS	PM PEAK HOUR Reserve Capacity	SAT PEAK HOUR LOS	SAT PEAK HOUR Reserve Capacity
Tremont/Ruggles Center Drive						
- w/Tremont right in/out						
Ruggles Center Drive	A	477	D	173	A	515



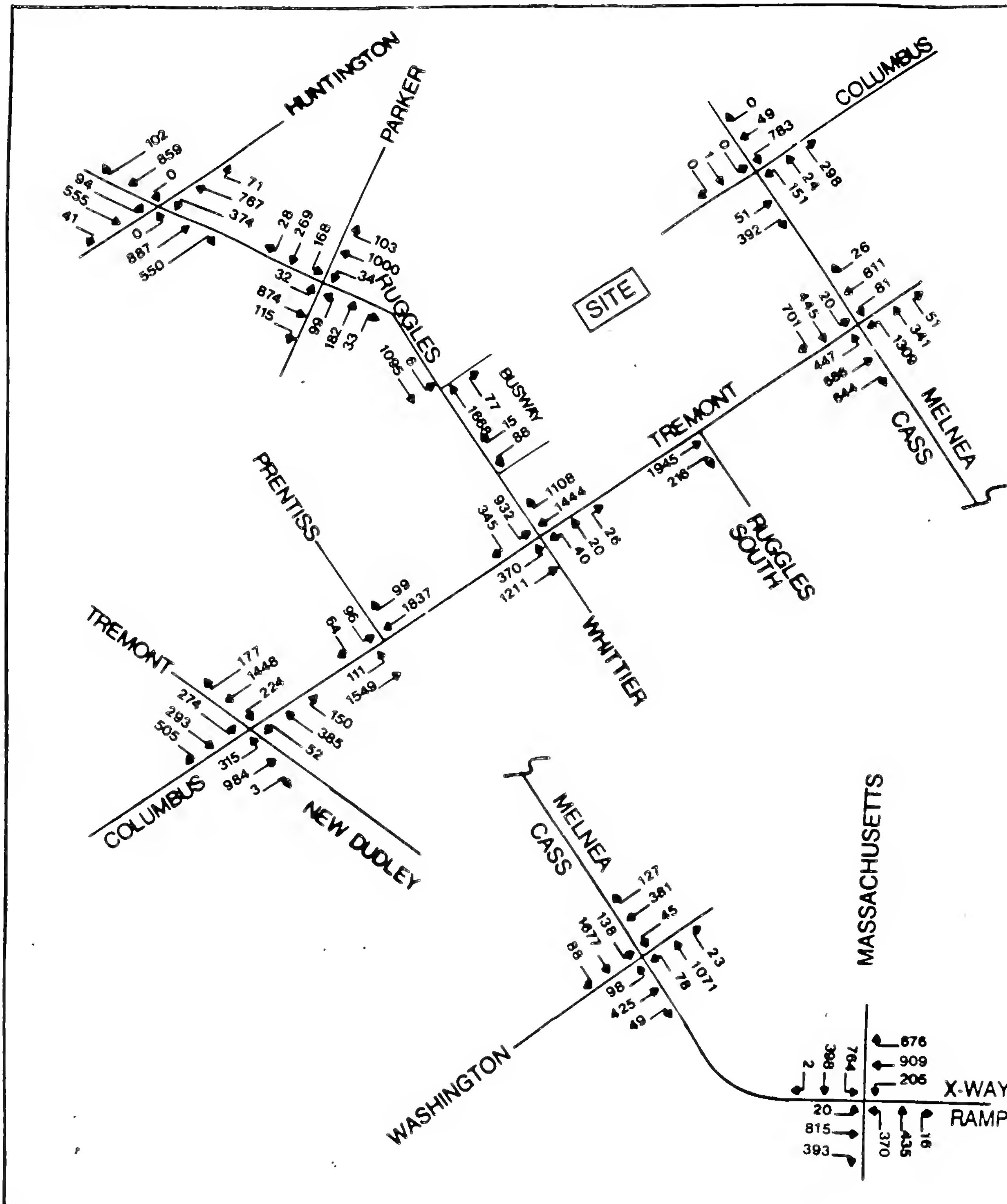
HOWARD/STEIN-HUDSON ASSOCIATES

Master Plan Design: AM Peak Hour Traffic Volumes

Melnea Cass Blvd. Access Only

N

Figure II A-18



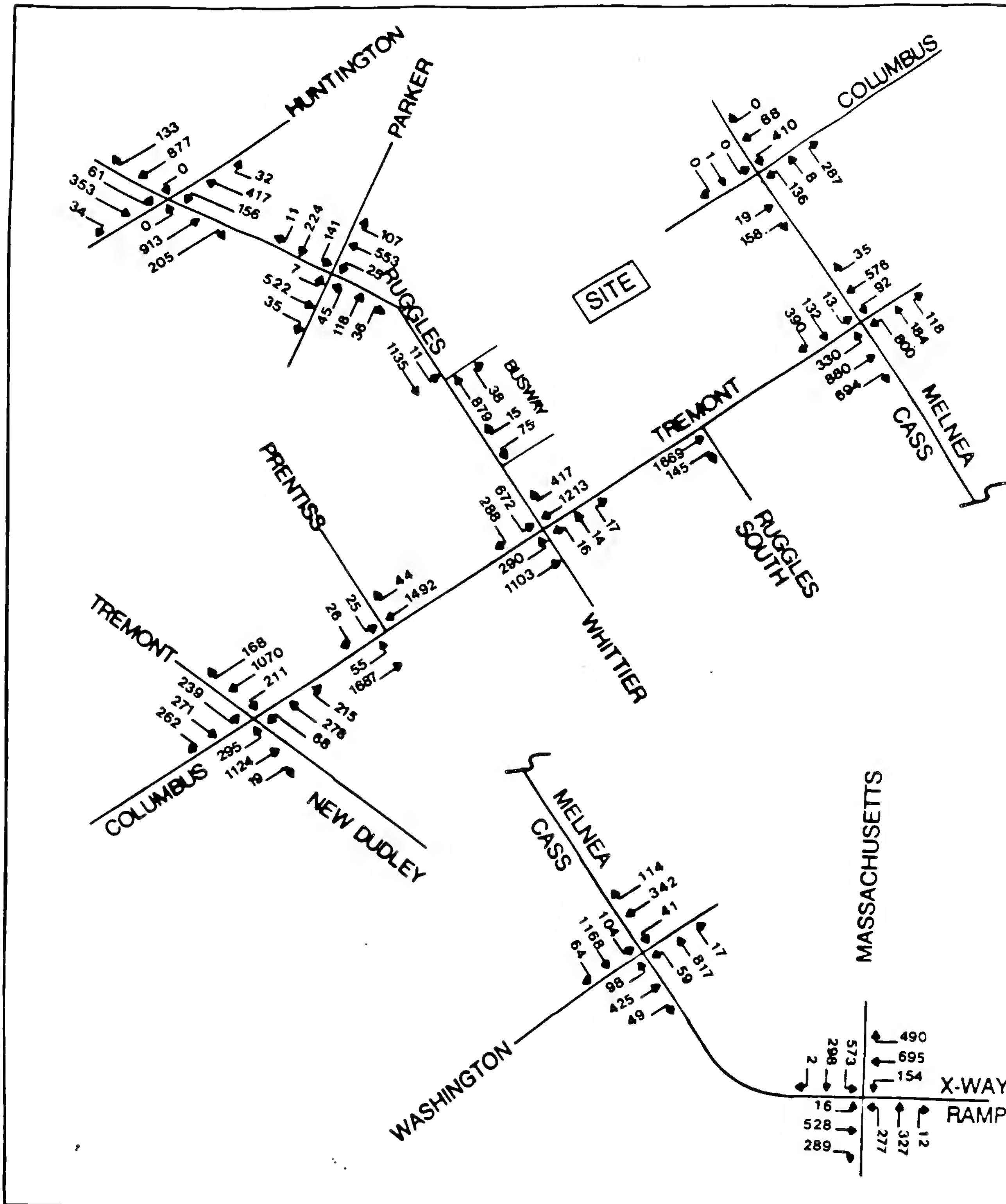
HOWARD/STEIN-HUDSON ASSOCIATES

Master Plan Design: PM Peak Hour Traffic Volumes

Melnea Cass Blvd. Access Only

N

Figure II A-19



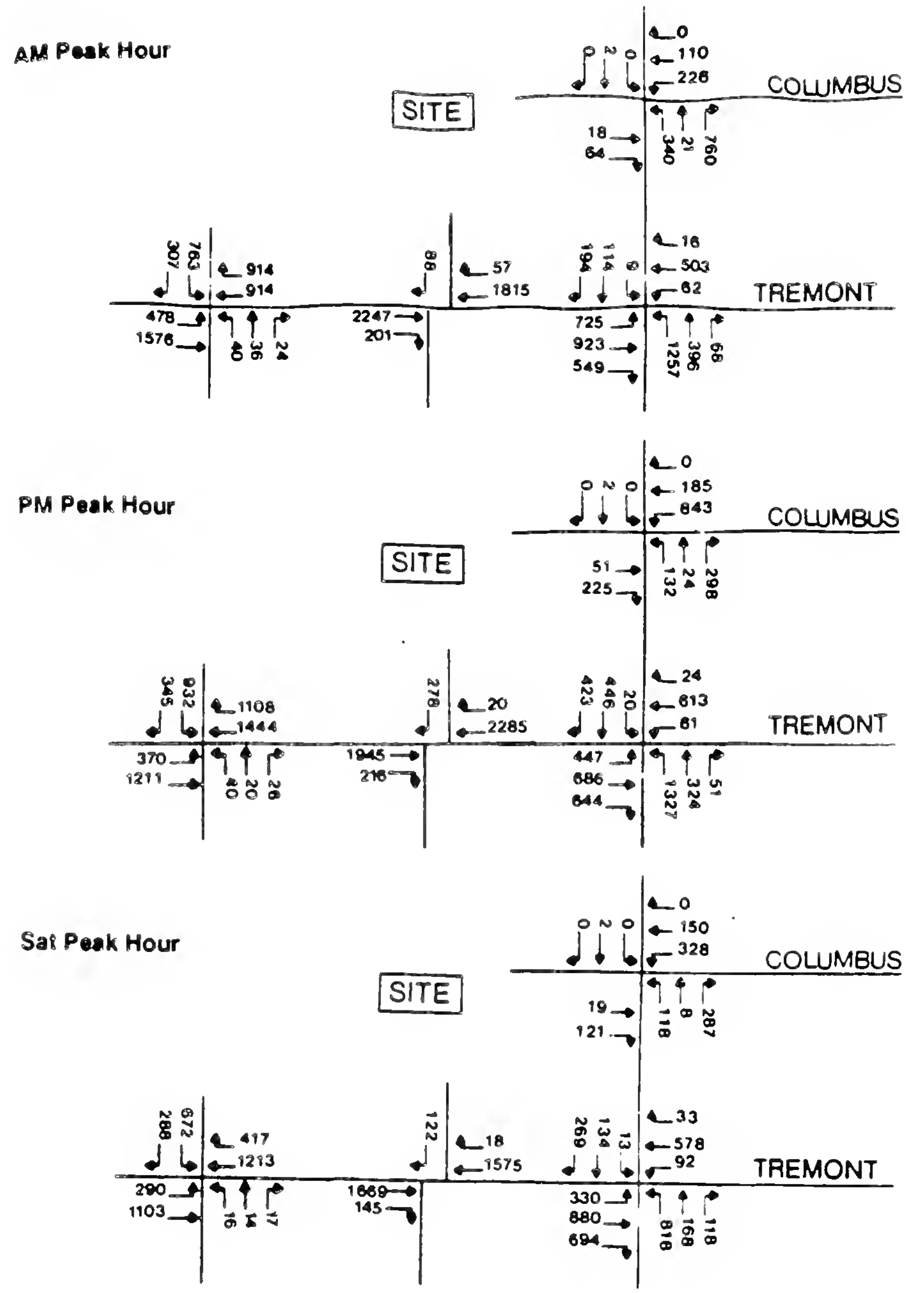
HOWARD/STEIN-HUDSON ASSOCIATES

Master Plan Design: Saturday Peak Hour Traffic Volumes

Melnea Cass Blvd. Access Only

N

Figure II A-20



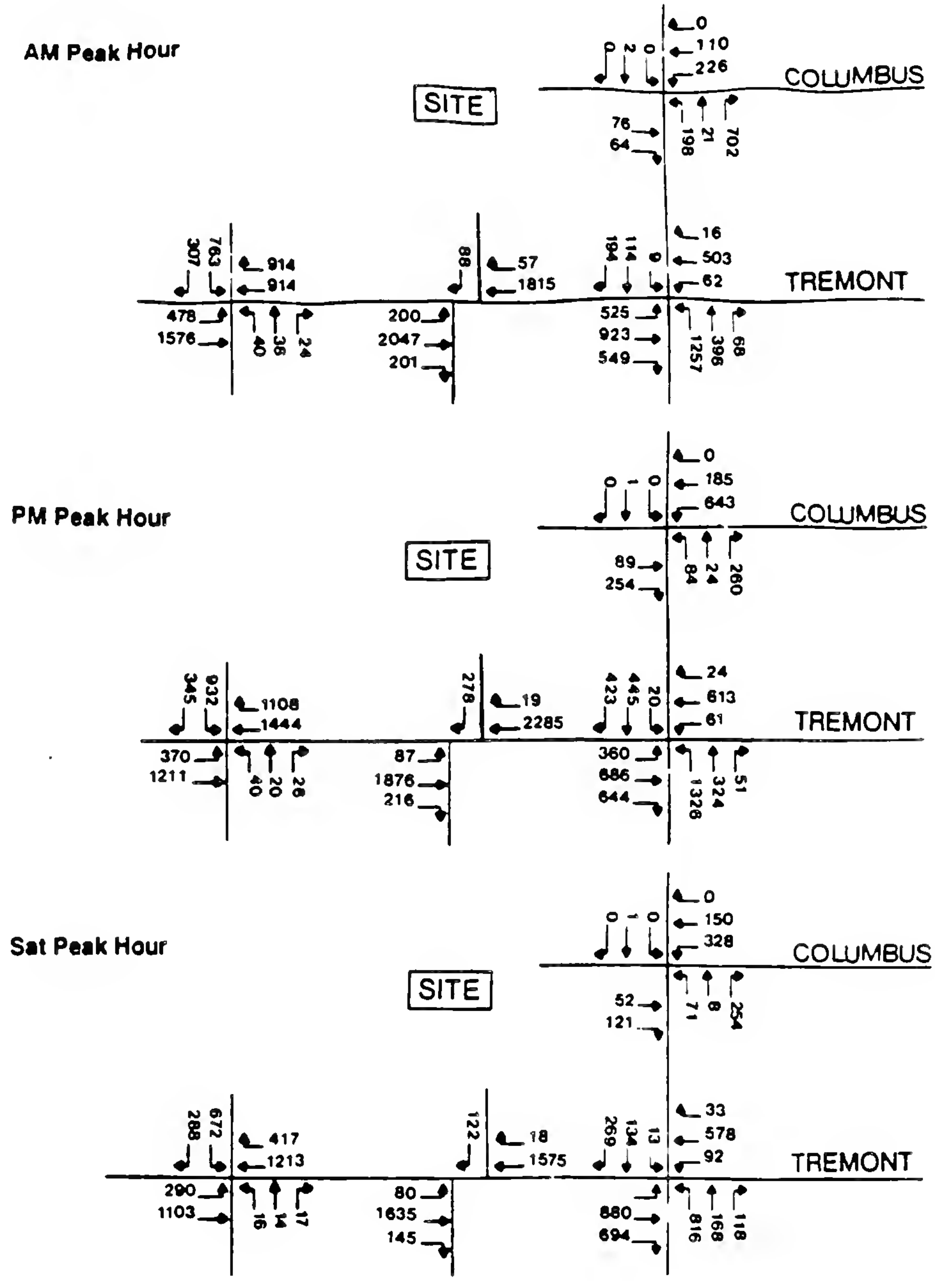
HOWARD/STEIN-HUDSON. ASSOCIATES

Master Plan Design (w/Tremont RGT In/Out Access) Traffic Volumes -

AM Peak Hour, PM Peak Hour and Sat Peak Hour

N

Figure II A-21



HOWARD/STEIN-HUDSON ASSOCIATES

Master Plan Design (w/Tremont Access) Traffic Volumes -

AM Peak Hour, PM Peak Hour and Sat Peak Hour

N

Figure II A-22

- Melnea Cass/Washington (LOS B to C).

Traffic operations impacts in terms of changes in LOS indicators during the evening peak hour period are more numerous than those of the morning peak hour. Impacts from the Master Plan Design change LOS designations at the following locations:

- Tremont/Ruggles/Whittier (LOS D to E);

- Tremont/Melnea Cass
  without Tremont access (LOS D to F);
  with Tremont right in/out (LOS D to E);

- Parker/Ruggles (LOS C to D);

- Melnea Cass/Columbus
  all access options (LOS A to C);

- Melnea Cass/Washington (LOS B to C); and

- Melnea Cass/Massachusetts/
  Southampton/X-Way Ramps (LOS C to D).

Traffic operations during the Saturday peak hour period remain within the existing LOS designation at all locations with the exception of the Melnea Cass/Columbus intersection which changes from LOS A to LOS B for all vehicular access options.

Although traffic generated by the Master Plan Design is expected to travel through many study area intersections, most locations remain within acceptable traffic operation levels. At most intersections, project generated traffic lengthens average vehicle delays by only a few seconds over the No Build condition. In response to EOTC's DEIR comment, it is of note that the Melnea Cass intersections with Washington Street and Massachusetts Avenue also operate at LOS D or better.

Project generated traffic does, however, produce significant impacts along Tremont Street intersections adjacent to the site. It is also evident from the analysis that vehicular access options for the Ruggles Center development has significant implications on traffic operations at the Tremont/Melnea Cass intersection.

To summarize, the following intersection locations along Tremont Street adjacent to the Ruggles Center site experience traffic impacts of unacceptable levels (without mitigation) for Build conditions under the Master Plan Design:

- Tremont/Ruggles/Whittier
  - PM peak hour (LOS D to E);

- Tremont/Melnea Cass
  - without Tremont access
    - AM peak hour (LOS C to E); and
    - PM peak hour (LOS D to F).
  - with Tremont right in/out
    - AM peak hour (LOS C to E); and
    - PM peak hour (LOS D to E).

Mitigation Measures Master Plan Design

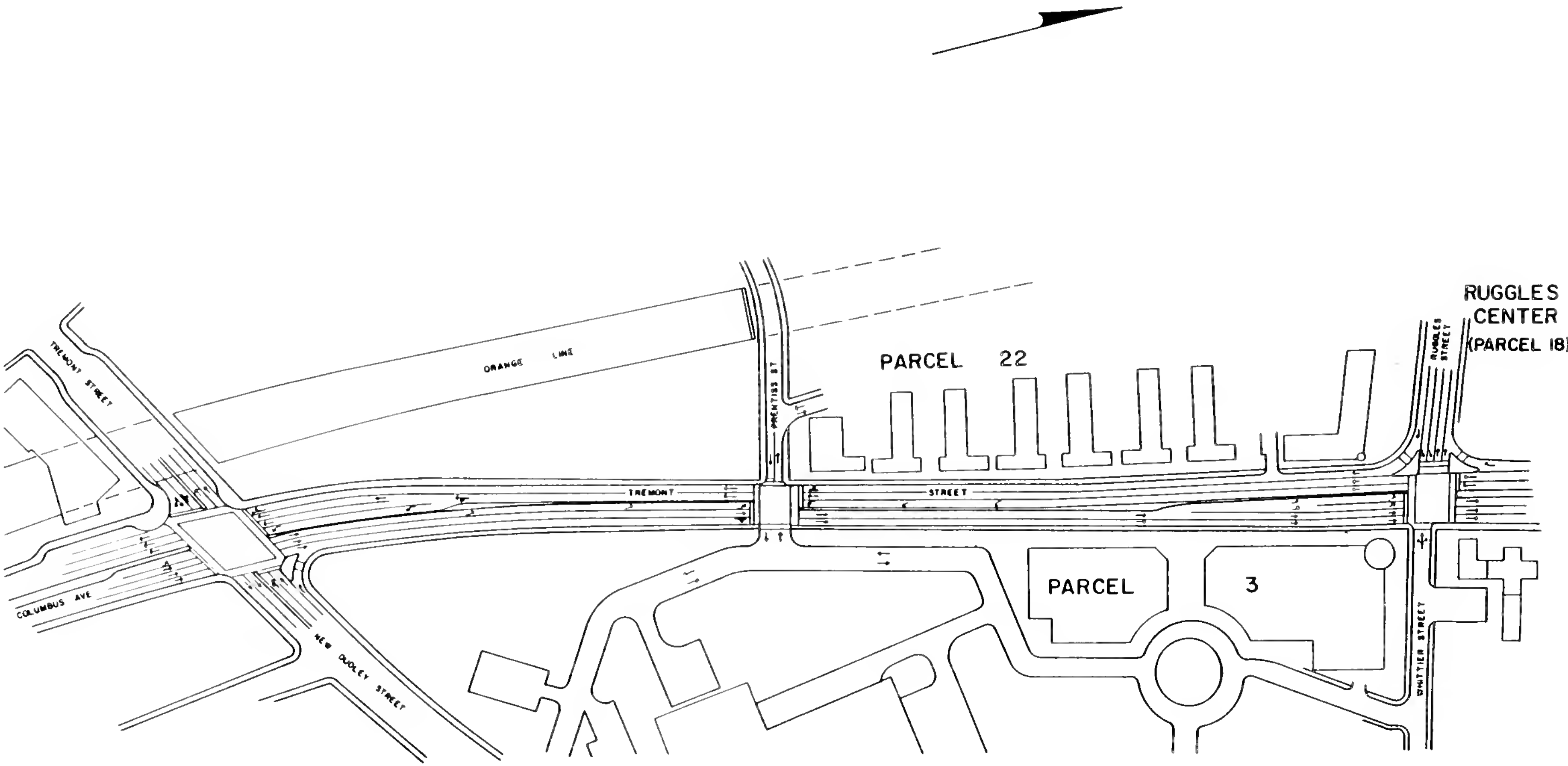
Mitigation to improve these traffic operations deficiencies due to traffic impacts of the Master Plan Design concentrates at the Tremont Street intersections adjacent to the site. These intersections are the most impacted by the Ruggles Center development since almost all of the project related traffic must traverse these locations prior to being distributed along study area roadways. The locations examined are the intersections of; Tremont/Ruggles/Whittier, Tremont/Melnea Cass and Tremont/Ruggles Center Drive. The traffic operation impacts of the three access options at Tremont/Melnea Cass and Tremont/Ruggles Center Drive are also addressed. In addition, the proximity of these intersections to each other along the Tremont Street corridor indicate that a queuing analysis be part of the overall traffic operations assessment.

Tremont/Ruggles/ Whittier Intersection

Improvements have been proposed by the MBTA at the Tremont/ Ruggles/Whittier intersection to facilitate bus turning movements. These improvements involve increasing the turning radius along the southbound Tremont Street approach to Ruggles Street and the eastbound Ruggles Street approach to Tremont Street. Although these improvements will facilitate bus turning movements at this location, they are not expected to improve overall LOS results.

Acceptable traffic operating conditions at the Tremont/Ruggles/ Whittier intersection can be obtained through the redesignation, with appropriate pavement markings, of existing travel lanes along the

Figure II A-23
Possible Long Term Roadway Improvements to Tremont Street
Between Ruggles Street and New Dudley Street



northbound Tremont Street approach, to provide two left turn lanes and two through travel lanes. Intersection improvements at this location should also include those planned by the MBTA. As indicated in Table II A-20, these mitigation measures at the Tremont/Ruggles/ Whittier intersection would improve traffic operations to acceptable conditions during all peak hour periods: LOS C in the AM peak, D in the PM peak, and B in the Saturday peak hour.

Table II A-20

Master Plan Design - Traffic Operations Summary with Mitigation

Tremont Street at Ruggles Street and Whittier Street

SIGNALIZED INTERSECTIONS

AM PEAK HOUR		PM PEAK HOUR		SAT PEAK HOUR	
LOS	Average Delay	LOS	Average Delay	LOS	Average Delay
C	18	D	27	B	12

Discussions with the City of Boston Transportation Department (BTD) indicate general agreement with the concept of the improvements proposed at this location; however, BTD has raised concern over protection of this additional northbound left turn lane from the generally fast travelling northbound through traffic. For the near term, general agreement exists for the use of improved signage and pavement markings, including the use of rubble strips, to segregate these two movements as a viable solution. Longer term solutions, however, along the Tremont Street corridor between New Dudley Street and Ruggles Street need to be addressed in terms of access to the other major developments on Tremont Street of Parcel P-3 and Parcel 22.

Access to both Parcel P-3 and Parcel 22, as are currently planned, will add traffic to the Tremont/Prentiss intersection. Figure II A-23 depicts a possible long term solution to access requirements along Tremont Street between Ruggles Street and New Dudley Street. Under

Table II A-21
Access Option Alternatives - - Traffic Operations Summary
Tremont Street at Melnea Cass Boulevard

(SIGNALIZED INTERSECTIONS)

	EXISTING GEOMETRY		NO BUILD IMPROVEMENTS		BUILD MITIGATION	
Condition	LOS	Average Delay	LOS	Average Delay	LOS	Average Delay
AM PEAK HOUR						
No Build Conditions	E	44	C	23	--	--
Master Plan Design						
- w/o Tremont access	--	--	E	51	C	22
- w/Tremont right in/out	--	--	E	50	C	22
- w/Tremont access	--	--	D	25	C	20
PM PEAK HOUR						
No Build Conditions	F	134	D	37	--	--
Master Plan Design						
- w/o Tremont access	--	--	F	84	F	93
- w/Tremont right in/out	--	--	E	50	D	35
- w/Tremont access	--	--	D	37	D	33
SAT PEAK HOUR						
No Build Conditions	D	27	C	17	--	--
Master Plan Design						
- w/o Tremont access	--	--	C	18	C	19
- w/Tremont right in/out	--	--	C	15	C	17
- w/Tremont access	--	--	C	15	C	17

this scenario, when access is required for both of these projects, the intersection of Tremont/Prentiss would be improved to allow for left turn storage lanes along both Tremont Street approaches.

Tremont Street southbound would operate with three lanes of through traffic exiting Ruggles Street. At Prentiss Street, southbound Tremont Street through traffic would narrow to two lanes with the provision of a left turn storage lane. Two lanes of through traffic exiting Prentiss Street would widen to three lanes plus a left turn storage lane at New Dudley Street. Tremont Street northbound would operate with three lanes of through traffic exiting from New Dudley Street and narrow to two lanes of through traffic approaching Prentiss Street, where a left turn storage lane would be established. Two lanes of through traffic would continue along Tremont Street from Prentiss Street to Ruggles Street, where the northbound Tremont Street approach would allow for two left turn storage lanes and two through lanes of traffic, as identified for the near term solutions at this location.

Tremont/Melnea Cass Intersection

As previously identified, vehicular access options for the Ruggles Center development have significant implications on traffic operations at the Tremont/Melnea Cass intersection. Table II A-21 summarizes the No Build and Build traffic operations analyses at the Tremont/Melnea Cass intersection for the three vehicular access options under the following roadway conditions: existing roadway geometry; roadway improvements identified for No Build conditions; and for the additional Build mitigation at this location as identified below.

Assuming the implementation of the proposed No Build roadway improvements at the Tremont/Melnea Cass intersection, the traffic operations analysis indicate this location to operate within acceptable LOS only under Access Option 3 (with Tremont access). This solution requires the provision of left turns from Tremont Street northbound into the site approximately mid-block between Melnea Cass Boulevard and Ruggles street. Comments on the DEIR identified concerns, however, regarding traffic operations along the Tremont Street block between Melnea Cass Boulevard and Ruggles Street, especially in terms of interference due to queue lengths at adjacent downstream locations.

Additional roadway improvements at the Tremont/Melnea Cass intersection, beyond those identified as necessary to provide acceptable traffic operations under No Build conditions, can improve

traffic operations under both Access Option 1 (without Tremont access) and Access Option 2 (with Tremont right in/out). Further improvements at this location include the provision of an additional northbound Tremont Street left turn lane, bringing the total northbound cross section to two left turn lanes, two through lanes and one right turn lane. Beyond these mitigating measures, however, further physical/operational mitigation at this location becomes difficult and major.

As previously identified, the analysis indicates that only Access Option 3 (with Tremont access) will operate at acceptable levels of service under the No Build roadway improvements. Access Option 2 (with Tremont right in/out) operates at acceptable conditions under the proposed Build mitigation at the Tremont/Melnea Cass intersection, while Access Option 1 (without Tremont access) does not operate at acceptable levels under either mitigation scenario.

In summary, for the Master Plan Design, two roadway improvement options provide adequate traffic operations at the Tremont/ Melnea Cass intersection:

- No Build improvements at the Tremont/Melnea Cass intersection combined with Access Option 3 (access from Tremont Street northbound to Ruggles Center approximately mid-block between Melnea Cass Boulevard and Ruggles Street); and

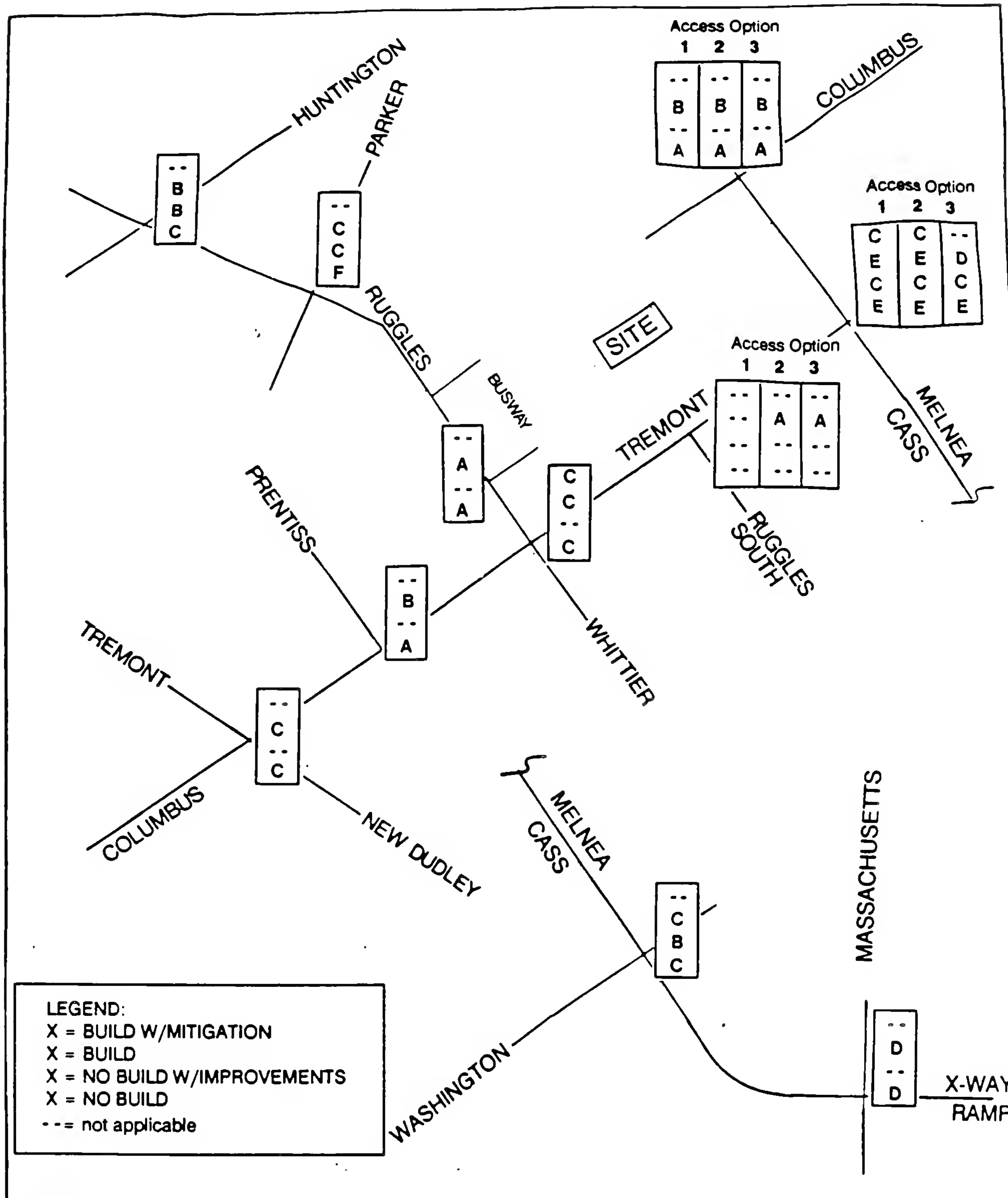
- Build mitigation at the Tremont/Melnea Cass intersection coupled with Access Option 2 (right turns in/out only at the Tremont/Ruggles Center Drive intersection).

The proper choice of access alternative, and thereby the associated level of mitigation required at the Tremont/Melnea Cass intersection, requires further analysis of the impacts of queuing on traffic operations at the three intersections along Tremont Street adjacent to the site, as presented below.

Ruggles Center Access Options - Queuing Analysis

The critical queue length is defined as the available vehicle storage along an intersection approach. Acceptable queue lengths in the analysis are those within the available queue storage.

The critical queue length along Tremont Street for Access Option 1 (without Tremont access) and Access Option 2 (with Tremont



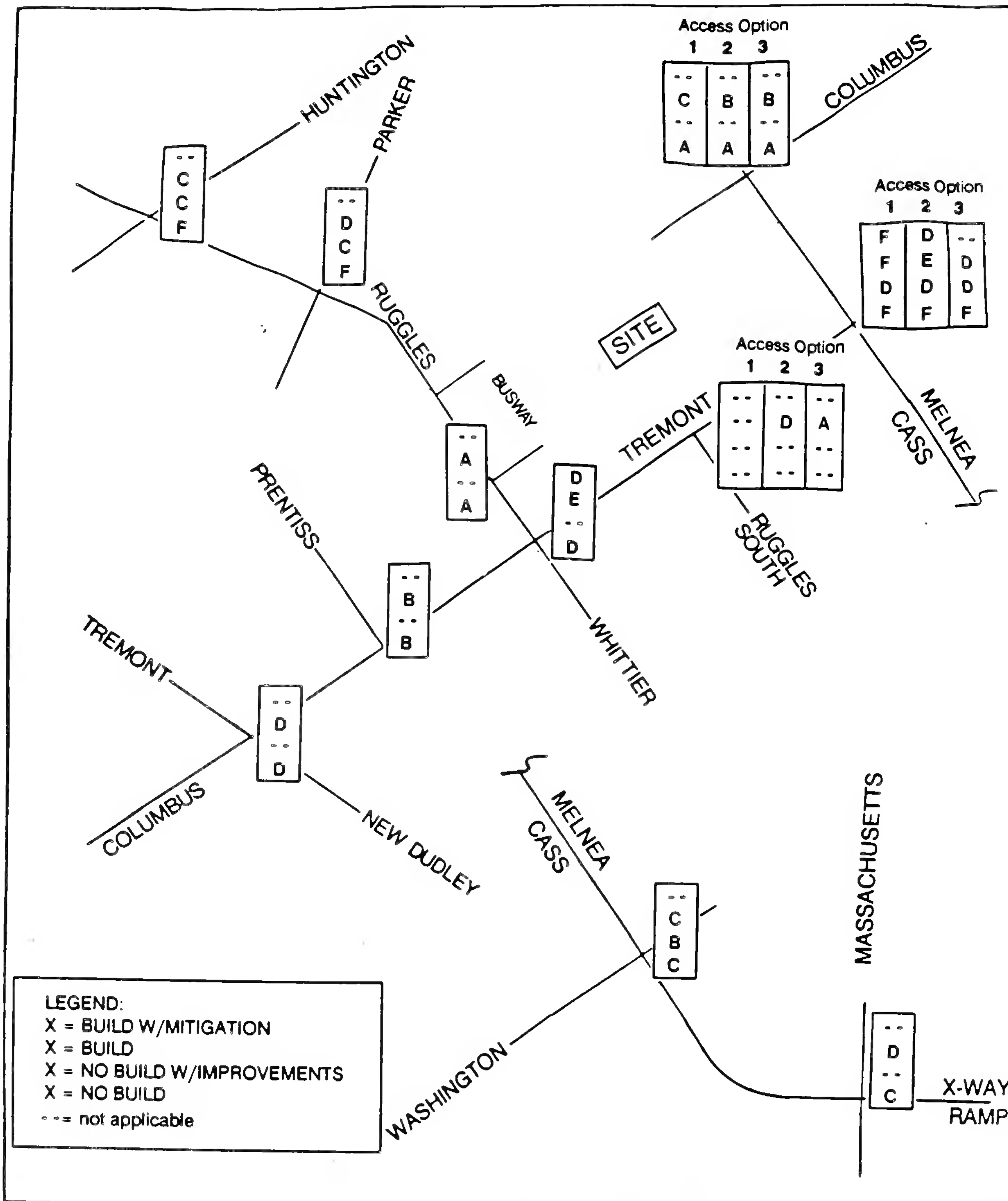
HOWARD/STEIN-HUDSON ASSOCIATES

Comparative 1996 Intersection Levels of Service:

AM Peak Hour

N ↑

Figure II A-24



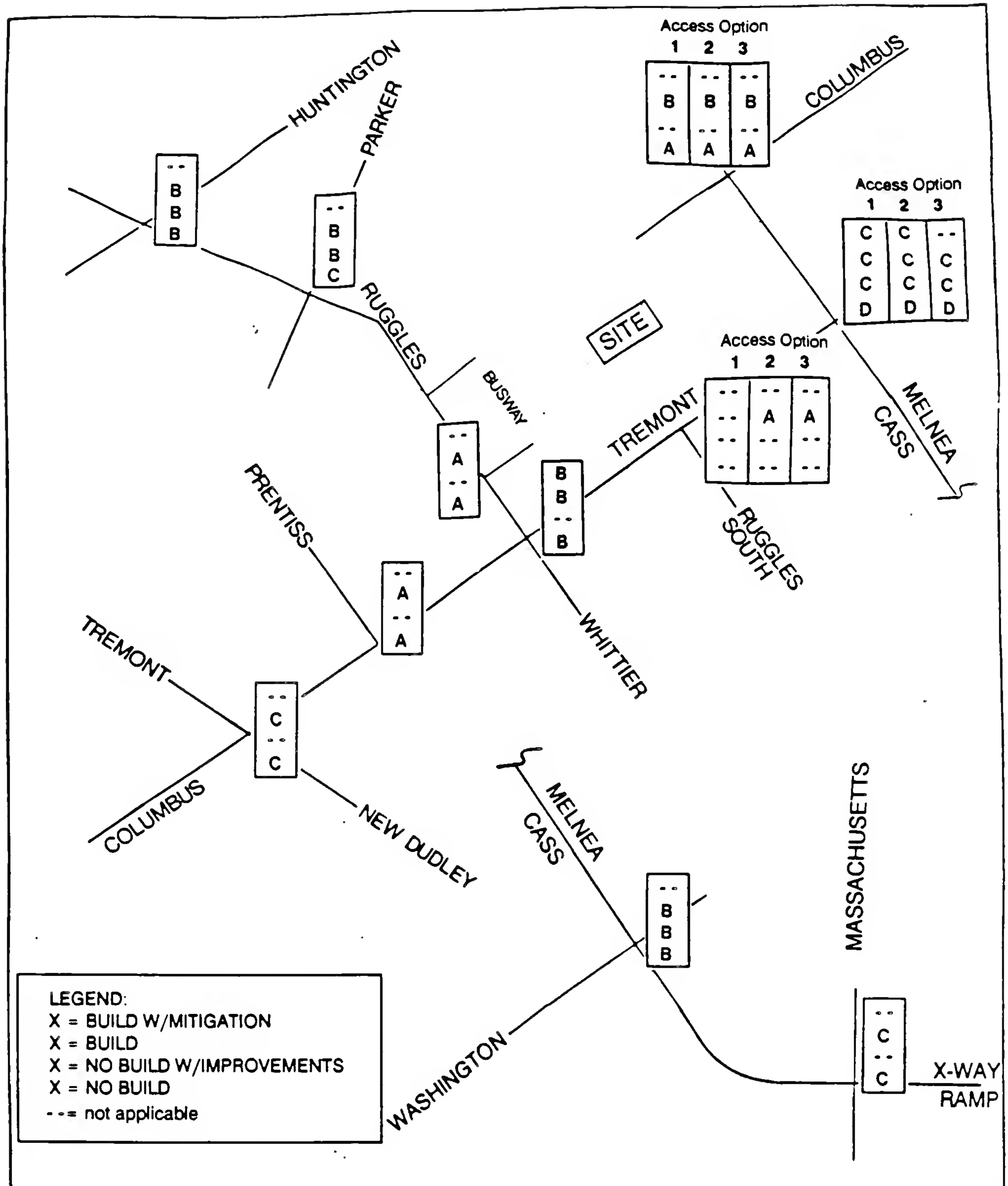
HOWARD/STEIN-HUDSON ASSOCIATES

Comparative 1996 Intersection Levels of Service:

PM Peak Hour

N ↑

Figure II A-25



HOWARD/STEIN-HUDSON ASSOCIATES

Comparative 1996 Intersection Levels of Service:

Saturday Peak Hour

N

Figure II A-26

Table II A-22
Access Option Alternatives - - Queue Length Analysis

SIGNALIZED INTERSECTIONS

	TREMONT/ RUGGLES Avg. Queue SB		TREMONT/ SITE DRIVE Avg. Queue NB		SB	TREMONT/ MELNEA CASS (w/No Bld imp) Avg. Queue NB		EB		TREMONT/ MELNEA CASS (w/Bld mtgn) Avg. Queue NB		EB	
	th	rt	lt	th	th	lt	th	th	rt	lt	th	th	rt
Available Queue Storage (by number of vehicles)													
w/o Tremont access	31	31	na	na	na	31	31	10	10	31	31	10	10
w/Tremont access	16	16	16	12	12	12	12	10	10	12	12	10	10
AM PEAK HOUR													
No Build Conditions	17	12	--	--	--	11	13	3	5	--	--	--	--
Master Plan Design													
- w/o Tremont access	16	8	--	--	--	23	13	6	5	16	16	4	6
- w/Tremont rt in/out	16	8	--	--	--	23	13	6	3	16	16	4	4
- w/Tremont access	16	8	5	0	16	11	15	4	4	13	17	3	4
PM PEAK HOUR													
No Build Conditions	30	14	--	--	--	12	12	10	10	--	--	--	--
Master Plan Design													
- w/o Tremont access	22	15	--	--	--	11	12	12	38	11	13	11	44
- w/Tremont rt in/out	16	16	--	--	--	16	12	16	8	12	13	12	13
- w/Tremont access	16	16	2	0	10	11	13	13	8	10	14	11	14
SAT PEAK HOUR													
No Build Conditions	19	4	--	--	--	7	14	2	8	--	--	--	--
Master Plan Design													
- w/o Tremont access	17	3	--	--	--	7	13	4	8	8	14	4	8
- w/Tremont rt in/out	17	3	--	--	--	8	13	4	6	8	14	4	6
- w/Tremont access	17	3	2	0	8	6	14	4	6	6	15	4	6

right in/out) extends the entire block between Melnea Cass Boulevard and Ruggles Street, at approximately 31 vehicles. For Access Option 3 (with Tremont access), approximately 16 vehicles can queue between the Ruggles Center Drive and Ruggles Street while the critical queue length between Melnea Cass Boulevard and the Ruggles Center Drive is about 12 vehicles. Along the eastbound Melnea Cass Boulevard approach to Tremont Street, the critical queue length is approximately 10 vehicles for all access options.

Table II A-22 presents the queue length analysis at each of the three intersections along Tremont Street adjacent to the site, including both the No Build improvements and Build mitigation at the Tremont/Melnea Cass intersection. The analysis is conducted for all three access options and is compared to the No Build conditions.

For all instances where LOS indicators are at unacceptable levels, the queue length analysis indicates that average queues at most locations are long and sometimes extend through the adjacent downstream intersection. The analysis also indicates that even where traffic operations in terms of LOS are within acceptable levels, queue lengths are generally long and often interfere with traffic operations at adjacent intersections, especially for Access Option 3 (with Tremont access) where available queue storage is more limited than the other access options.

During the morning peak hour period, although queues are long they are at acceptable levels (within the available queue storage) for the Master Plan Design with Access Option 1 (without Tremont access) and Access Option 2 (with Tremont right in/out). For Access Option 3 (with Tremont access), queues extend through adjacent intersections along the southbound Tremont Street approach to the Ruggles Center Drive and along the northbound Tremont Street approach to Melnea Cass Boulevard.

For the Master Plan Design, acceptable queue lengths along Tremont Street are again provided during the evening peak hour period by Access Option 1 and Access Option 2. Vehicle queues from Access Option 3 extend through the intersection of Tremont/Melnea Cass from the intersection of the Tremont/Ruggles Center Drive.

All access options provide for queue lengths that extend along the eastbound Melnea Cass approach at Tremont Street to the Columbus/Melnea Cass intersection during the evening peak hour. Access

Option 2 offers the least interference from vehicular queues with traffic operations at the Columbus/Melnea Cass intersection.

During the Saturday peak hour period, Access Options 1 and 2 provide for acceptable queue lengths along Tremont Street while queues from Access Option 3 extend along the Tremont Street southbound approach to Ruggles Street through the intersection of Tremont/Ruggles Center Drive.

For the two roadway options identified above as viable solutions to traffic operations impacts associated with the Master Plan Design, the queue length analysis is the deciding factor. The roadway option that produces acceptable LOS and queue lengths is Access Option 2 that provides for right turns in/out of the Ruggles Center Drive at Tremont Street combined with the Build mitigation at the intersection of Tremont Street and Melnea Cass Boulevard.

Mitigation Measures

Roadway Improvements

No Build Alternative

Roadway improvements in the study area focus on the Ruggles Street corridor and on the intersections adjacent to the Ruggles Center development along Tremont Street.

The following intersection locations require roadway improvements without the addition of Ruggles Center generated traffic and are therefore not the responsibility of the project proponent:

- Huntington Avenue at Ruggles Street;
- Ruggles Street at Parker Street; and
- Tremont Street at Melnea Cass Boulevard.

The improvements necessary at each of these locations have been previously identified. Once implemented, each of the three intersections will operate at LOS D or above during both peak periods. Roadway improvements are currently in the design stage along the Ruggles Street corridor from Tremont Street to Huntington Avenue. These improvements will be funded through the Urban Systems Fund and are currently expected to be completed by 1993.

No Build roadway improvements at the Tremont/Melnea Cass intersection are not currently in either the planning or design stages. Although these improvements would improve current traffic conditions and are important to maintain acceptable traffic operations under

No Build conditions, any improvements to this intersection should take into consideration further changes that will be necessary with the Master Plan Design development of Ruggles Center.

Master Plan Design

The intersections along Tremont Street adjacent to proposed Ruggles Center have been identified as locations that require roadway improvements as a direct result of project generated traffic. The affected roadway includes Tremont Street from Ruggles Street to Melnea Cass Boulevard and includes the intersections of:

- Tremont Street at Ruggles and Whittier Streets;
- Tremont Street at the Ruggles Center Drive; and
- Tremont Street at Melnea Cass Boulevard.

The suggested roadway improvements along this section of Tremont Street and the associated intersection improvements are presented in Figure II A-27. In addition to the improvements identified, the current push-button actuated pedestrian signal located at the south side of Ruggles Street south will remain in the future to ensure safe crossing of Tremont Street at this important point for Ruggles Station and the development, although it is proposed to be moved to the north side of the intersection to allow for additional queue storage along the southbound Tremont Street approach. Given the recommended improvements, each of the three intersections will operate at LOS D or above during both peak periods. The developer will continue to work with BTD, MBTA and other City and State agencies to determine appropriate action regarding the Build mitigation measures along this section of Tremont Street.

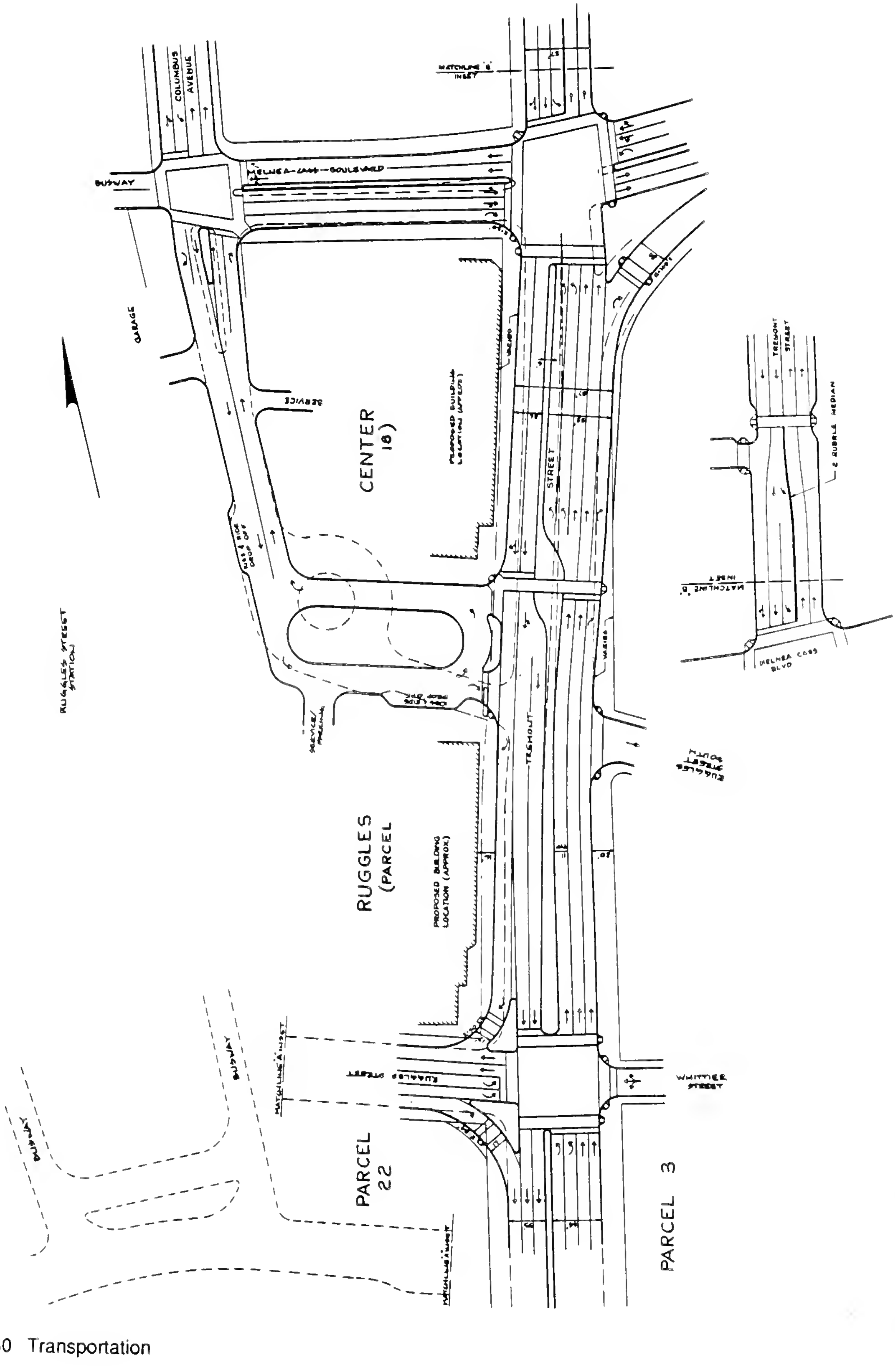
Parking Supply and Demand Impacts

As stated above, existing parking supply in the study area consists primarily of Northeastern University temporary parking lots on redevelopment parcels, most of which are scheduled to be replaced by structured parking as the vacant parcels are redeveloped. Parking is not a problem in the remainder of the area today, as so much of the land is vacant. Nevertheless, the community has expressed concern that adequate parking be provided on-site for Ruggles Center and other commercial developments in the area.

No Build Alternative

To forecast the need for parking space in 1996, a baseline estimate of parking demand was prepared and compared to the total parking supply that will be available. Table II A-23 lists parking supply and demand within the study area for development expected to occur

Figure II A-27
Suggested Roadway Improvements Surrounding Ruggles Center



from 1988 to 1996. Not counted as new parking supply was Northeastern University's planned 500 car garage. This is a replacement facility and will not available to the public.

The supply/demand calculation yielded an overall deficit of 447 spaces within the study area for 1996.

Master Plan Design

Parking demand for the Master Plan Design was then determined through applying average parking duration, arrival time, and turnover rates for each land use to the vehicle trips developed in the trip generation analysis. Work trip vehicles are assigned as all day parkers for each land use. Nonwork trip vehicles are assigned a turnover rate of 3 for retail trips (i.e. three cars are assumed to use each space during the course of a day), and 2.67 for office non-work trips. Hotel non-work parking patterns are more similar to residential uses than commercial uses in that they peak in the evening. Hotel parking was thus assumed at 35% levels during the peak hour (approximately 2:00 PM). Daycare non- work parking is also unique and is related to the need for a small number of very short-term, high turnover, pickup/dropoff spaces (estimated at three spaces). The resulting parking demand, compared to the proposed supply for the build alternative is shown in Table II A-24.

As shown in the table, the build alternative will generate a demand for 1,225 parking spaces. Of this total demand, 933 spaces will be needed for employees, and 292 spaces will be needed for nonwork purposes (i.e., customers and visitors).

Table II A-24 also shows proposed parking supply for the Master Plan Design, compared to the total project demand. As shown, there is a deficit of 250 parking spaces. The proposed spaces are sufficient to cover 100% of the employee demand, and 14% of the nonwork demand. When the No Build study area deficit of 447 spaces is taken into account, the overall study area deficit is 697 spaces, under the current auto use and car occupancy assumptions.

Because a deficit was noted, the results of the parking demand analysis was checked against a methodology employed by the Urban Land Institute for calculating parking demand. This method, described in the manual Shared Parking (Urban Land Institute, 1982), uses commonly accepted standards of spaces per square feet, then applies local mode split and car occupancy factors to arrive at demand for a particular location. Under this methodology, the total demand for

Table II A-23
Parking Demand Analysis: Ruggles Center
Background Development

Parameter	Residential Work	Residential Nonwork	Office Work	Office Nonwork	Retail: Work	Retail: Nonwork	Total: Work	Total: Nonwork	Total
Daily Vehicles (in and out)	2052	2792	2519	1046	575	3254	5146	7092	12238
Round Trips (1/2 daily vehicles)	1026	1396	1260	523	288	1627	2573	3546	6119
Peak Demand	541	0	1260	196	288	542	2088	738	2826
New Parking Proposed (excluding Northeastern replacement parking garages):									2379
Surplus or Deficit:									-447

Assumptions:

* Residential peak demand based on one space/dwelling unit; 2/3 gone during the day
* All retail, office work trips included in peak demand
* Retail nonwork divided by 3.0 turnover
* Office nonwork divided by 2.67 turnover
* Cultural Center: 30% of employee trips, 20% of nonwork trips in peak demand

Table II A-24
Parking Demand Analysis: Ruggles Center
Master Plan Design

	Hotel		Office		Retail		Daycare		Total		
Parameter	Work	Nonwork	Work	Nonwork	Work	Nonwork	Work	Nonwork	Work	Nonwork	Total
Daily Vehicles (in and out)	188	987	1508	611	126	694	43	122	1865	2414	4279
Round Trips (1/2 daily vehicles)	94	494	754	306	63	347	22	61	933	1208	2141
Peak Demand	94	58	754	115	63	116	22	3	933	292	1225
New Parking Proposed											975
Surplus or Deficit											-250

Assumptions:

* Hotel peak demand based on one space per work round trip; nonwork turnover of 3, 35% parked during peak (2 pm)
* All retail, office work trips included in peak demand
* Retail nonwork divided by 3.0 turnover
* Office nonwork divided by 2.67 turnover
* Daycare nonwork is for three spaces only, to accomodate short-term pick up and drop off of children.

Table II A-25
Assignment of Public Transportation Trips Generated by Project and Background Development

AM PEAK HOUR, PEAK DIRECTION -- INBOUND

Line/Direction	Percent Distrib.	No Build Trips	Master Plan Design	Total Trips
Orange/North	35.0%	310	163	473
Orange/South	20.0%	177	93	270
Green/West	2.0%	18	9	27
Green/East	10.0%	89	47	136
Bus	30.0%	266	140	406
Commuter Rail	3.0%	27	14	41
Total	100.0%	887	466	1,353

PM PEAK HOUR, PEAK DIRECTION -- OUTBOUND

Line/Direction	Percent Distrib.	No Build Trips	Master Plan Design	Total Trips
Orange/North	35.0%	391	157	548
Orange/South	20.0%	224	89	313
Green/West	2.0%	22	9	31
Green/East	10.0%	112	45	157
Bus	30.0%	335	135	470
Commuter Rail	3.0%	34	14	48
Total	100.0%	1,118	449	1,567

the Master Plan Design is 941 spaces, and there is a surplus of 34 spaces, and the areawide deficit is reduced to 413. One reason for the difference is that the ULI model forecasts a demand for only 456 office employee spaces, where the CSI model demand is 754 office employee spaces.

In fact, to help encourage transit use and increase car occupancy, it is desirable not to meet 100% of employee demand, (although a certain number of spaces per thousand square feet must be provided to tenants in order to lease the space). This can be done through reducing the total number of spaces, or by reducing the proportion of spaces leased to tenants (presumably for subsidized employee parking) and increasing the number of market rate commercial spaces. This policy would be likely to result in increased carpooling or transit use by those who did not have a subsidized space, thus reducing demand. For example, if car occupancy were increased to 1.5 from the 1.24 projected, 771 employee spaces would be necessary to accommodate the 1156 workers instead of 933. In this location, increased transit use is the more likely result due to the excellent transit access.

As stated in the parking mitigation section which follows, parking management is an integral part of overall transportation policy for the development. Allocation of spaces to tenants, the distribution of employee versus public spaces, pricing and day to day management of the facility can be adjusted to help maximize space utilization for residents, customers, and visitors and to reduce employee auto use. This type of parking management should be applied to the No Build projects as well, both to help maximize space utilization and to reduce parking demand, both of which will help reduce the study area 1996 parking deficit.

Public Transportation System Impacts

As stated above, the impacts of the Ruggles Center development project on the public transportation system will be most pronounced in three areas:

- Orange Line north and south of the site;
- Green Line (E Line) north and south of the site; and
- Bus routes serving the site.

No Build Alternative

The total public transportation trips for the 1996 No Build background development were assigned to each transit/bus line, as shown in Table II A-25. As shown, the background development in the

study area will add almost 900 public transportation trips inbound (to downtown Boston) in the AM peak hour and around 1,120 trips outbound in the PM peak hour. These trips represent approximately two peak hour carloads of passengers on the Orange Line north of the site, and less than one carload on the Green Line East. Trips generated by the commercial uses in the area will have little impact on these lines because they will be added to the off-peak direction. Impacts on the Orange Line South and Green Line West will also be insignificant, because riders will board and alight south of the peak downtown load points for each line during either peak hour. While downtown-bound trips generated by the residential uses will be added to the peak loads, these trips account for only 17% of AM peak hour public transportation trips and 35% of PM peak hour public transportation trips.

The No Build background development growth is projected to add 266 trips to southwest corridor bus routes serving Ruggles Station in the morning peak and 335 trips in the evening peak. This represents 3-4 bus loads of passengers (at 75 seated and standing passengers per bus) if all were added to the same route. In fact, the passengers will be distributed over the 14 bus routes serving the station (see Table II A-3), lessening the impacts on any one route.

Master Plan Design

Following the estimation of No Build public transportation trips, trips for the Master Plan Design were added to the No Build riders to determine 1996 total added ridership. These figures are also shown in Table II A-21. The Master Plan Design is expected to add 163 passengers to the Orange Line North, 140 passengers to the bus routes, and 93 passengers to the Orange Line South in the AM peak hour. Nine passengers will be added to the Green Line West and 47 passengers will be added to the Green Line East in the AM peak hour. These figures are all slightly lower for the PM peak hour. While the total trips for this option increase the transit trips over the No Build case by 40% in the evening and 53% in the morning, the total impacts are still easily handled by the MBTA system.

The 140 additional bus passengers could be served by two additional buses (at 75 seated and standing passengers per bus) if all passengers were traveling on the same bus route. Since there are 14 bus routes that serve the Ruggles Center area (see Table II A-3), service may have to be added to one or more routes to accommodate this demand, depending on the number of riders added to a given route. The additional ridership that will be added to the Orange Line could be

accommodated by the equivalent of one additional car in each direction. Ridership added to the Eastern portion of the Green Line is less than 10% of the capacity of one car, and less than 35% of the capacity of one car on the Western section.

Pedestrian/ Bicycle Impacts

In keeping with the City of Boston's urban design goals, Ruggles Center has been designed to strengthen pedestrian activity in the area, and to reinforce and extend development along Columbus Avenue and Tremont Street, both major radial boulevards. A central pedestrian plaza extending from Tremont Street to the Ruggles Station entrance is planned as a focal point for the project. As illustrated in Figure II A-28, retail uses and building lobbies will open to this plaza, in addition to retail uses and building entries planned for Columbus Avenue Extension and Tremont Street. Wide sidewalks will be provided along all streets and on both sides of the plaza. In addition, the Southwest Corridor open space easement will be maintained as a landscaped open space, connecting some of the buildings within the development to Ruggles Station. To the north, the pedestrian improvements planned by Northeastern University for Forsyth Street between Huntington Avenue and Ruggles Station will reinforce the station linkages, as well as providing improved pedestrian access between Tremont Street, Ruggles Center, Columbus Avenue, the Northeastern campus, and Huntington Avenue.

Pedestrian volumes generated by the Master Plan Design are outlined in Table II A-26. As shown, 7,167 pedestrians will be generated by the project during an average weekday (including public transportation riders and walk trips). Expected weekday peak hour, peak direction pedestrians are about 650. A total of 3,875 trips will be generated on an average Saturday; 108 trips are expected to be made during the Saturday peak hour (peak direction). Given the fact that these trips are being introduced into an area with very little pedestrian activity today, the volumes can be accommodated by the sidewalks and crosswalks with no difficulty.

Bicycle use of the path adjacent to the site is projected to be increase from 34 bicycles in the AM peak hour in 1989 to 50 bicycles in the AM peak hour in 1996, as a result of background development of the project. (These trips are included in the walk category. Bicycles are assumed to account for about 10% of the walk/other mode, or about 1% of total daily Ruggles Center person trips.)

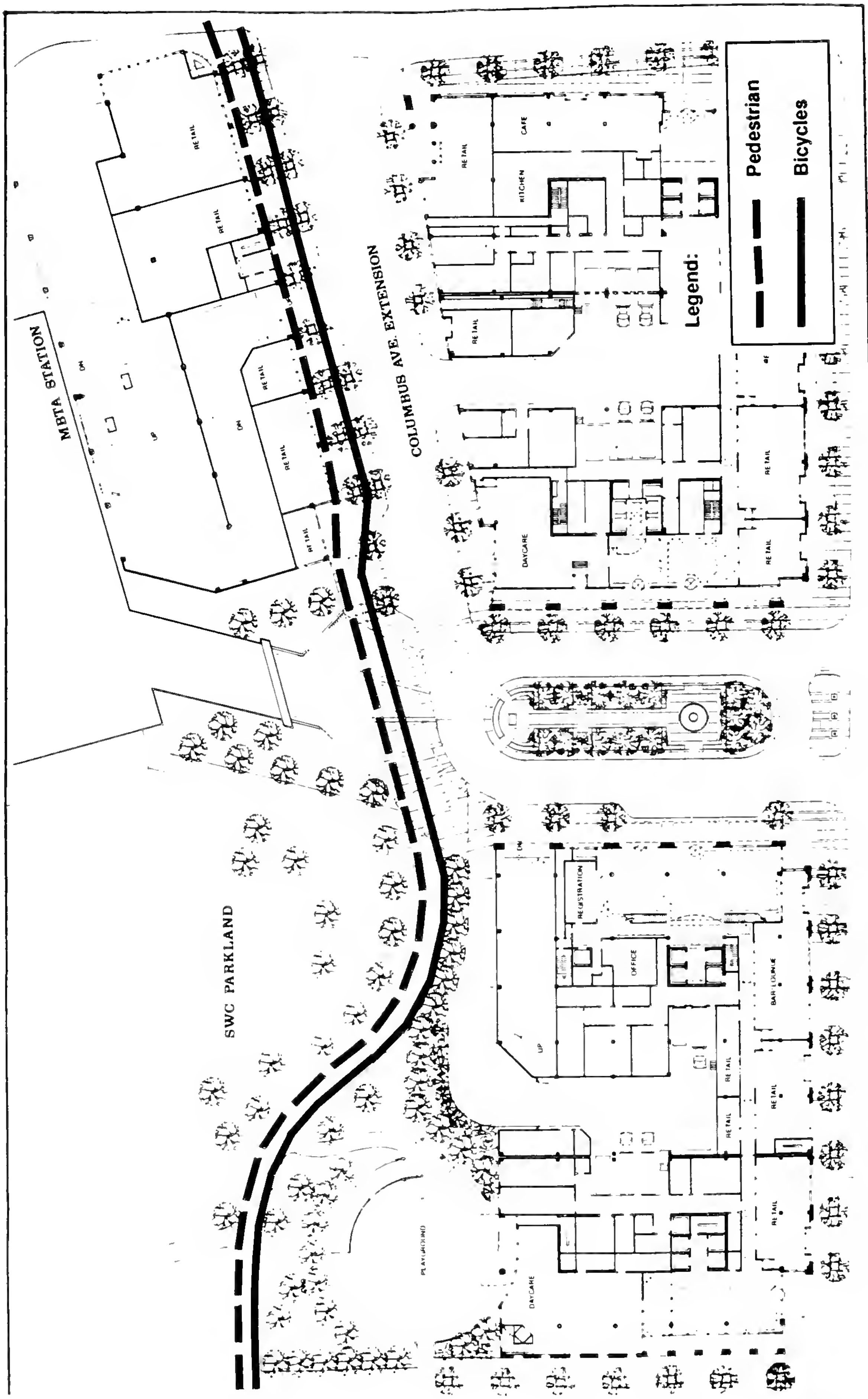


Figure II A-28

Proposed Pedestrian and Bicycle Path in Site Area

Master Plan Design

Table II A-26
Ruggles Center Pedestrian Trip Generation Summary
Master Plan Design

Time Period	To/From Transit	Walk	Total
Average Daily	4,328	2,839	7,167
AM Peak			
Entering (in)	467	201	668
Leaving (out)	90	95	185
PM Peak			
Entering (in)	142	130	272
Leaving (out)	449	203	652
Saturday Total	2,187	1,688	3,875
Saturday Peak			
Entering (in)	108	91	199
Leaving (out)	95	79	174

The bicycle path will remain basically the same throughout the site, except for a change south of the station. Presently, the pedestrian path and bicycle path are separate at this location and join in front of the station entrance. In the proposed plan, the two paths will be joined south of the station. There will be one thirty foot sidewalk extending through the site. As shown in Figure II A-28, the entire fifteen foot section will be for pedestrian use and the outer fifteen feet is intended to be used by bicyclists. North of the entrance, the paths are separated by trees.

Signage will direct pedestrians and bicyclists to the appropriate paths. There will also be signage at the parking garage entrances and a stop sign for cars as they exit the parking garage. Bicyclists will continue to travel past the station entrance on the bike path and will have to slow speeds in order to avoid pedestrians, as they do today.

Additional Mitigation Measures

It should be stressed that the future traffic conditions in the area of the proposed development involve heavy traffic volumes in limited roadway space. Although mitigation measures involving physical, operational and circulation changes will bring about acceptable conditions for the next few years, in the long run, mitigation will have to lean heavily on greater use of transit, carpooling, and other management, demand side measures. This will not only be necessary for the development covered by this report, but for established and other planned developments. Some of these commute management measures are articulated below.

Future pedestrian, bicycle and vehicular activity at Ruggles Center will require appropriate signage and pavement markings to direct pedestrian, bicycle and vehicular movements along desired alignments and designated pathways for each individual use.

Pedestrian demand across Tremont Street adjacent to the Ruggles Center site is moderate at the present time and almost non- existent across Ruggles Street. The existing actuated crosswalk signals at the Tremont Street intersection with Ruggles and Whittier Streets and at Tremont Street and Ruggles Street South are adequate to handle current pedestrian demand. The numbers of pedestrians at these locations do not warrant pedestrian overpasses.

Encourage Transit Use

The prime location of Ruggles Center with respect to the Orange Line, Green Line and feeder bus service makes encouragement of transit use a primary mitigating measure. In the first place, the

developer can stress the site's excellent transit access in the marketing materials prepared during the initial leasing process for the building. Once tenants are selected, transit access can be stressed in employment recruitment. As mentioned earlier, the feeder bus access also offers an excellent opportunity to recruit a large transit dependent labor force, reducing auto use and, at the same time, helping meet City of Boston objectives for employment of City residents. Employment advertising by major tenants in MBTA buses and trains will help tap this work force. Once the building is operational, MBTA pass sales can be arranged on site, either in a sales office run by building management in one of the buildings or through payroll deduction by the employers. Employers can also be encouraged to offer a small subsidy of the MBTA pass; even a 25% subsidy (less than $10 per month) is very effective in increasing transit use.

Encourage Ridesharing

In the Boston region, developers and employers can utilize the services of CARAVAN, the regional ridesharing agency, to help initiate ridesharing programs, including carpools, vanpools, and subscription bus services. One particularly effective service which CARAVAN offers is assistance to new tenants in solving relocating employees' commuting problems. This service can be utilized by the developer during the leasing process to help market the space. Once employers are located, CARAVAN will help them implement ridesharing programs and form employee carpools. The State has several funding programs in place to support private sector efforts as well. CARAVAN has been very active to date in the Longwood Medical Area nearby.

The Ruggles Center developer and building manager can also support ridesharing efforts through parking pricing and supply management. As stated below, the balance between employee supply and visitor supply must be carefully worked out for Ruggles Center, since 100% of the projected parking demand cannot be met. Reserving a pool of monthly spaces for carpools and vanpools, perhaps at a slightly reduced rate, is one way to help insure ridesharing if parking supply is short. Pricing of the visitor supply to discourage all-day parking is also necessary.

Flexible Work Hours

Largely beyond the control of the project developer is institution of flexible working hours, in other words, arrangements whereby employees can vary working schedules to avoid peak demand periods. The receptivity of employers to these types of programs varies by the type of business. Informally, the developer can distribute information about these programs to prospective tenants, and also keep track of the

working hours of major tenants during the leasing process to help coordinate schedules, if possible.

Transportation Coordinator

One key to successful implementation of these actions is an active effort by the developer to incorporate the idea of demand management into project marketing and leasing in a very positive way. This can be done through offering the services of a transportation coordinator, who can be designated from the existing marketing staff. This individual can work with CARAVAN to learn about available programs, prepare the required promotional materials, and launch ridesharing and transit efforts as appropriate. Once the project is fully tenanted, the function can be carried out as part of the building management on an ongoing basis.

B. Utilities

Introduction

The Master Plan Design substantially reconfigures the land use allocations at Ruggles Center. When compared with the Developer's Alternative examined in the Draft Environmental Impact Report (DEIR), office space is reduced almost 24 percent and retail space is increased 36 percent. These changes, particularly the reduction in office space, noticeably alter the demand for utilities. Thus, a new demand analysis for the project was performed.

The utility demand analysis which follows shows that local area supply networks are adequate to handle Ruggles Center demand for water, sewer and power provided that conservation practices are observed.

Project Demand

Water

The demand for water includes water needed for domestic use and for make-up water, a principal component of the air conditioning/heating system. As Table II B-1 shows, average daily air conditioning make-up water and domestic water were estimated separately for each building and each major land use within a building. Special consideration was given to water demands generated by the restaurant, bar and cafe planned for Ruggles Center. Total daily demand for water at Ruggles Center is estimated as follows:

	gpd
Air Conditioning Make-Up Water	102,490
Domestic Water	113,745
Total	216,235

In addition to average daily demand for water, peak water demand was also estimated. This calculation is particularly important to ensure that system capacity within Ruggles Center and the local supply networks can handle periods of peak load. Peak water demand was estimated only for domestic water. Estimates of air conditioning make-up water take into account variations in the outside temperature but are not dependent on the number of users.

Average peak domestic water use for Ruggles Center has been estimated using a saturation population projection of 6,500. This projection embodies a full complement of employees, hotel guests, conference attendees, shoppers, restaurant clientele, and children at the day care drawing on the system.

Table II B-1 Water Demand

Parcel [1]	Land Use [2]	Sq. Footage [3]	Air Conditioning Capacity (Tons) [4]	Air Conditioning Make-Up Water (GPD) [5]	Domestic Water (GPD) [6]	Total Daily Water (GPD) [5]+[6]
18A	Office	155,625	440	14,260	13,420	27,680
	Retail (incl. cafe)	9,650	65	2,460	7,795	10,255
18B	Office	224,850	640	24,190	19,390	43,580
	Retail	6,375	45	1,700	360	2,060
	Day Care	3,200	15	560	180	740
18C	Hotel/Restaurant	199 Rooms	800	38,880	53,590	92,470
	Retail (incl. bar)	5,200	35	1,320	6,540	7,860
18D	Office	128,400	370	13,990	11,080	25,070
	Retail	1,800	15	600	105	705
	Day Care	10,000	40	1,510	575	2,085
18E	Garage	226,225	None	0	50	50
	Retail	11,375	80	3,020	660	3,680
	Totals	968,175	2,545 0	102,490	113,745	216,235

Notes
1) Office square footage includes lobby and service area.
2) Minimum fire flow: Offices - 750 GPM; Hotel - 1,500 GPM
3) Air conditioning make up water based on peak summer day.

Peak flow is dependent on the size of the population served. The greater the population, the lower the peaking factor (see Figure II B-1.) A factor of 4.1 has been used to determine the peak demand on the water system at Ruggles Center. Peak usage is estimated as follows:

Parameter	gpd	gpm
Avg. Daily Demand	216,235	150.2
Peak Demand @ 4.1 Peaking Factor	568,845	395.0

Sanitary Sewer and Storm Flow

Waste water is the principal discharge into the sanitary sewer system. For this analysis, it is assumed that much of the air conditioning make-up water will evaporate in cooling towers. Storm runoff will discharge into the storm drains and combined sewers.

Average daily sanitary flows are a function of water usage and shown by building on Table II B-2. Ruggles Center will contribute an average of 98,640 gpd to the sanitary sewer system. Peak sanitary flow is estimated to be 404,424 gpd. Table II B-3 shows calculation of both peak sanitary and storm flows.

Calculation of storm flow is based on the following runoff assumptions: (1) landscaped open space with a runoff coefficient of 25 percent; (2) paved open space with a 90 percent runoff coefficient; and (3) the building footprint with a 95 percent runoff coefficient. Peak storm flow is estimated to be approximately 22.78 cfs.

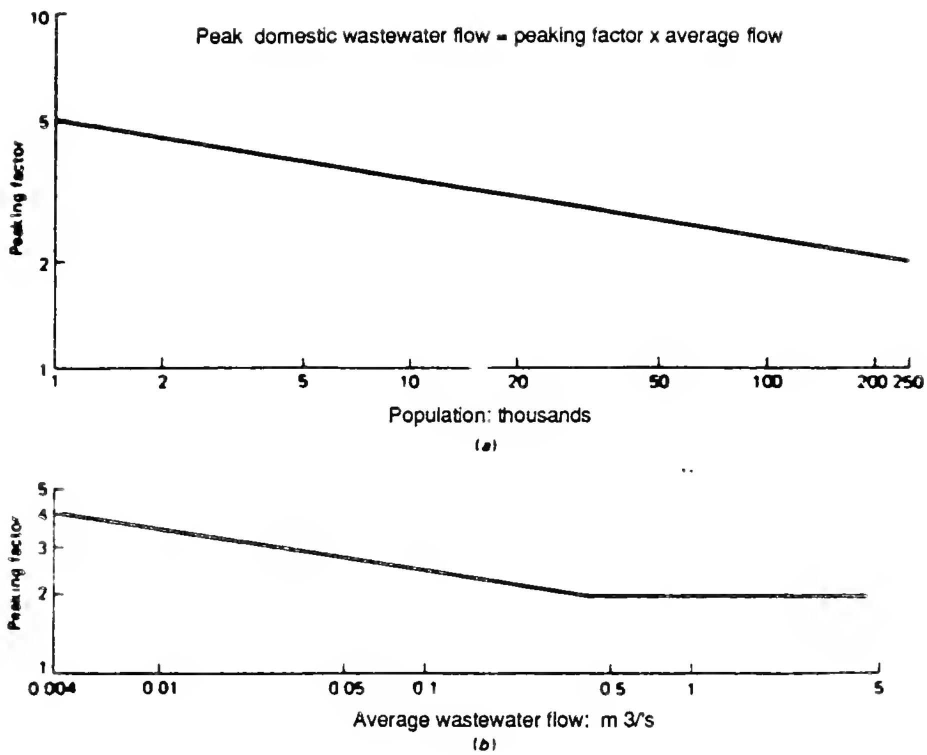
Total peak storm and sanitary flow is estimated at 23.41 cfs.

Electric Power

Overall peak demand for electric power is 6.7 megawatts based on estimates shown in Table II B-4. The largest electrical demand comes from office use. With the reduction of office space in the Master Plan Design, peak demand estimates are notably lower.

Electric power demand requirements were estimated on a gross square footage using the following generally accepted building design criteria:

— All electric design with the exception of gas hot water and cooking for hotel;



Source: Wastewater Engineering: Treatment Disposal Reuse, McGraw-Hill, New York 1979

Figure II B-1
Water and Wastewater Flow Peaking Factor

Table II B-2 Sewer Demand by Building

Parcel	Land Use	Sanitary Sewer (GPD)
18A	Office	11,400
	Retail (incl. cafe)	6,780
18B	Office	16,860
	Retail	320
	Day Care	160
18C	Hotel/Restaurant	46,600
	Retail (incl. bar)	5,685
18D	Office	9,630
	Retail	90
	Day Care	500
18E	Garage	45
	Retail	570
	Totals	98,640

Notes:

1) Office square footage includes lobby and service area.
2) All storm v All storm water will discharge to street sewer.

Table II B-3 Sanitary Sewer and Storm Flows

Land Use	Sq. Footage	Average Daily Sanitary Flow (GPD)	Peak Sanitary Flow (GPD)
Office	508,875	37,890	155,349
Retail	34,400	13,445	55,125
Hotel/Restaurant	185,475	46,600	191,060
Day Care	13,200	660	2,706
Garage	226,225	45	185
Totals	968,175	98,640	404,424

Storm Flow	Sq. Footage	Runoff Factor	Storm Flow (CFS)
Building Footprint	125,270	95%	13.93
Paved Open Space	79,270	90%	8.32
Landscaped Open Space	18,000	25%	0.53
Total Storm Flow	222,540		22.78
Peak Sanitary Sewer Flow	222,540		0.63
Total Storm and Sanitary Flow			23.41

Notes:

1) Office space includes lobby and service area.
2) Hotel/Restaurant also includes lobby in Building 18C.
3) Sanitary sewer flow assumes that much of air conditioning make-up water evaporates in cooling towers.
4) Peaking factor for sanitary discharge is estimated at 4.1 times average daily flows.

Table II B-4 Peak Electric Demand

Land Use	Basis watts/sf	Sq. Footage	Watts	Megawatts
Office	10	470,470	4,704,700	4.70
Retail	8	34,400	275,200	0.28
Day Care	8	13,200	105,600	0.11
Hotel/Restaurant	6	165,850	995,100	1.00
Lobby/Service	6	58,030	348,180	0.35
Garage	1	226,225	226,225	0.23
Totals		968,175	6,655,005	6.66

Table II B-5 Gas Demand

Parcel	Land Use	Square Footage	Gas (CFH)
18A	Office	155,625	3,000
	Retail (incl. cafe)	9,650	180
18B	Office	224,850	4,500
	Retail	6,375	150
	Day Care	3,200	80
18C	Hotel/Restaurant	199 Rooms	15,000
	Retail (incl. bar)	5,200	100
18D	Office	128,400	2,500
	Retail	1,800	40
	Day Care	10,000	270
18E	Garage	226,225	
	Retail	11,375	225
	Totals	968,175	26,045

Notes:

1) Gas consumption for retail areas depends on tenant occupancy; gas for cooking to be provided for hotel.

2) Domestic hot water for office, retail and day care will be provided by local electric water heaters; for the hotel, hot water will be provided by central gas water heaters.

3) Office sq. footage also includes lobby and service areas.

- Office space at 10 watts/sf with moderate computer and equipment use;
- Day care space at 8 w/sf;
- Retail space with overhead lighting and some incandescent display lighting at 8 watts/sf;
- Hotel space at 6 watts/sf;
- Lobby/Service space at 6 watts/sf;
- Garage space at 1 watt/sf (assume 325 sf/space).

Gas

The demand for gas is closely connected to building use. Table II B-5 shows estimates of peak gas use for each of the five buildings at Ruggles Center. A total peak load of 26,045 cfh is estimated. Variations in specific building uses and selection of heating fuels will influence final demand.

Adequacy of Supply Networks

Summary

The existing BWSC water system within the project area can meet the supply demands of the Master Plan Design. Extension of a water main in the Columbus Avenue Extension may be necessary to provide some connections. The sewer and storm drain systems servicing the project site are adequate. The Boston Edison Company has plans to upgrade the electric distribution system in the area to meet future demands. The electrical demand for the project can be supplied by Boston Edison Company's existing 13.8 kV distribution system and converted by a transformer in an internal vault in the building. Upgrading of the system, however, will be necessary to meet increasing demands as the Ruggles Street area around and adjacent to the project site is renovated/redeveloped. The gas system is considered adequate to meet the estimated project requirements. The Boston Gas Company, however, reserves the right to review each connection application individually and will generally make system adjustments as necessary.

Water Supply

The City of Boston, as well as other metropolitan area communities, obtains its water from the Quabbin/Wachusetts Reservoir System. The immediate supply point, the Norumbega Reservoir, is fed by the Wachusetts system. This system is the largest artificially created drinking water supply in the world. The system has a safe daily yield capacity of 300 million gallons. However, the current total use exceeds 320 million gallons per day (mgd), a shortfall of 20 to 40 mgd. This shortfall is expected to increase in the future to more than 50 mgd by 1993 unless additional supplies are found or conservation efforts are more successful.

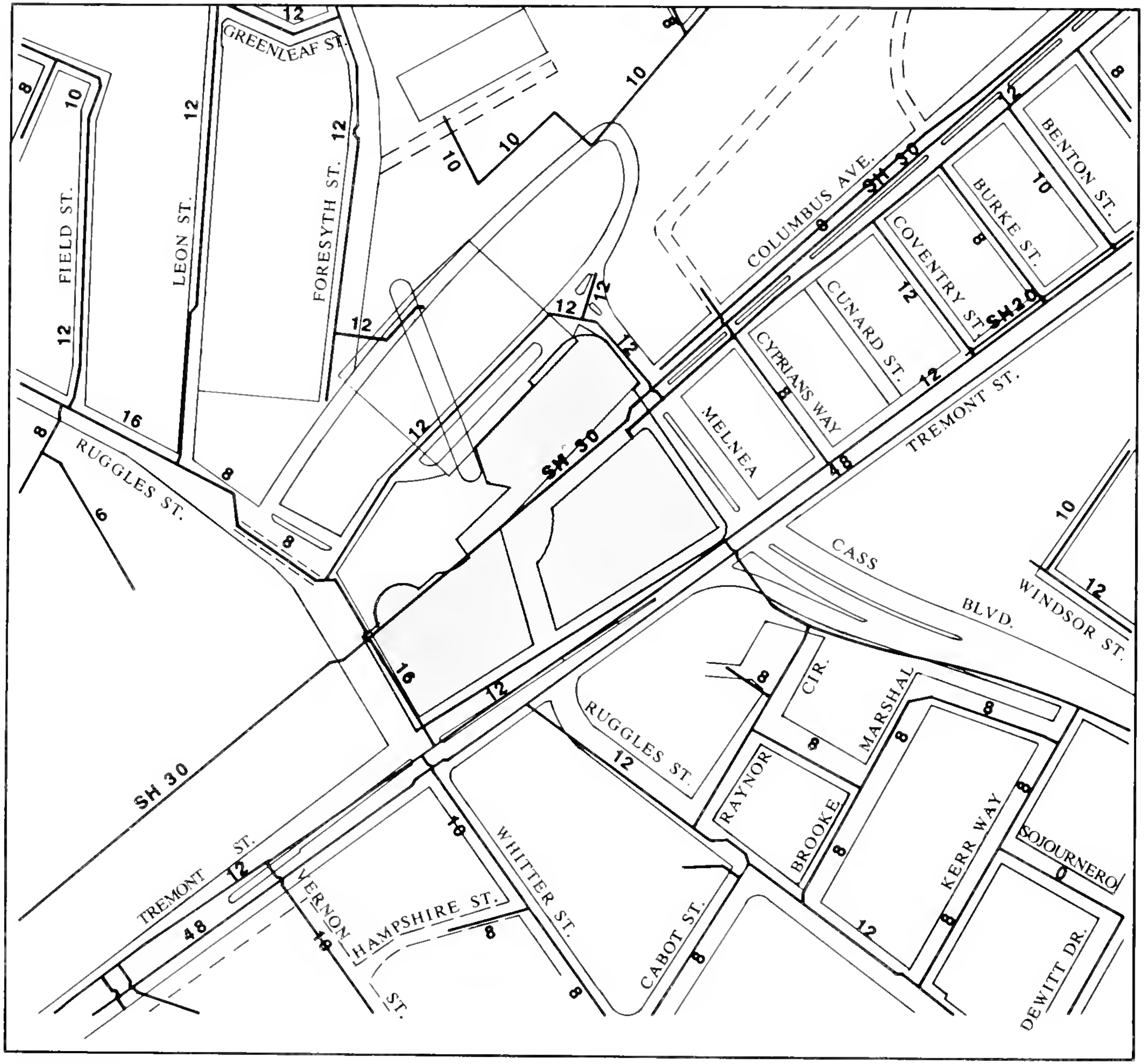


FIGURE II B-2
RUGGLES CENTER PROJECT AREA - WATER SERVICE SYSTEM

NOTES:

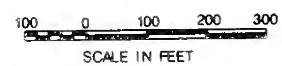
1. ALL WATER MAINS ARE CONSTRUCTED OF THE FOLLOWING MATERIALS;
   A. PIT CAST IRON (P.C.I.)
   B. DUCTILE IRON (D.I.)
   C. CAST IRON CEMENT LINED (C.I.C.L.)

2. ALL DISTRIBUTION PIPES SHOWN ARE THE SOUTHERN LOW SERVICE AREA UNLESS PRE-FIXED WITH THE DESIGNATED SH WHICH IDENTIFIES THE SOUTHERN HIGH SERVICE (SH) DISTRIBUTION SYSTEM.

3. SHADED AREA DESIGNATES LIMITS OF PROJECT DEVELOPMENT FOR THE RUGGLES CENTER.

LEGEND

6 WATER MAIN WITH PIPE DIAMETER



Water for consumption and fire service is distributed to the project location by the Boston Water and Sewer Commission (BWSC) via their Southern Low Service mains. Service main sizes in the streets contiguous to the project site are indicated on the system map shown as Figure II B-2 — Water Service System.

The low service systems provide sufficient water for fire fighting requirements. Hydrant tests performed in the vicinity confirm the availability of over 3,000 gpm at 60 psi from the low pressure service. These quantities are sufficient for normal fire fighting purposes.

The estimated peak water demand of 339.9 gpm at Ruggles Center represents less than 20 percent of the flow available at a fully opened hydrant. This water would be drawn from several connections to the various low service mains on Tremont Street, Ruggles Street, and Columbus Avenue. In this manner, pressure drops are spread over a larger portion of the water supply system. No perceptible impacts are to be expected.

Additional hydrant tests will be performed to verify the integrity of the water supply system at the site itself as the project proceeds in design.

The estimated 216,235 gpd water usage would increase the demand on the Quabbin Reservoir by approximately .07 percent. Some of this water demand would be shifted from other areas within the MWRA water supply service area. In general, the proposed development will only minimally affect the demand for water. The project proponent, however, recognizing that the safe yield of the Quabbin Reservoir is already exceeded, will incorporate into the design water conserving facilities to ensure efficient use of water.

Sanitary Sewers and Storm Flow Capacity

Ruggles Center will be served by sanitary sewers, storm drains, and combined sewers owned and maintained by the Boston Water and Sewer Commission (BWSC.) These sanitary and storm sewers are part of Drainage Area D-16 as described in the recently completed Boston Wastewater Facilities Plan (Metcalf & Eddy, 1985). A sewer system map is shown as Figure II B-3. Table II B-6 evaluates the capacity of the sewer system in the project area.

Future sanitary flows from the site will be collected by 10-inch, 12-inch, and 15-inch sewers with capacities from 3 to 4 cubic feet per second (cfs) located in Tremont Street and Columbus Avenue. All

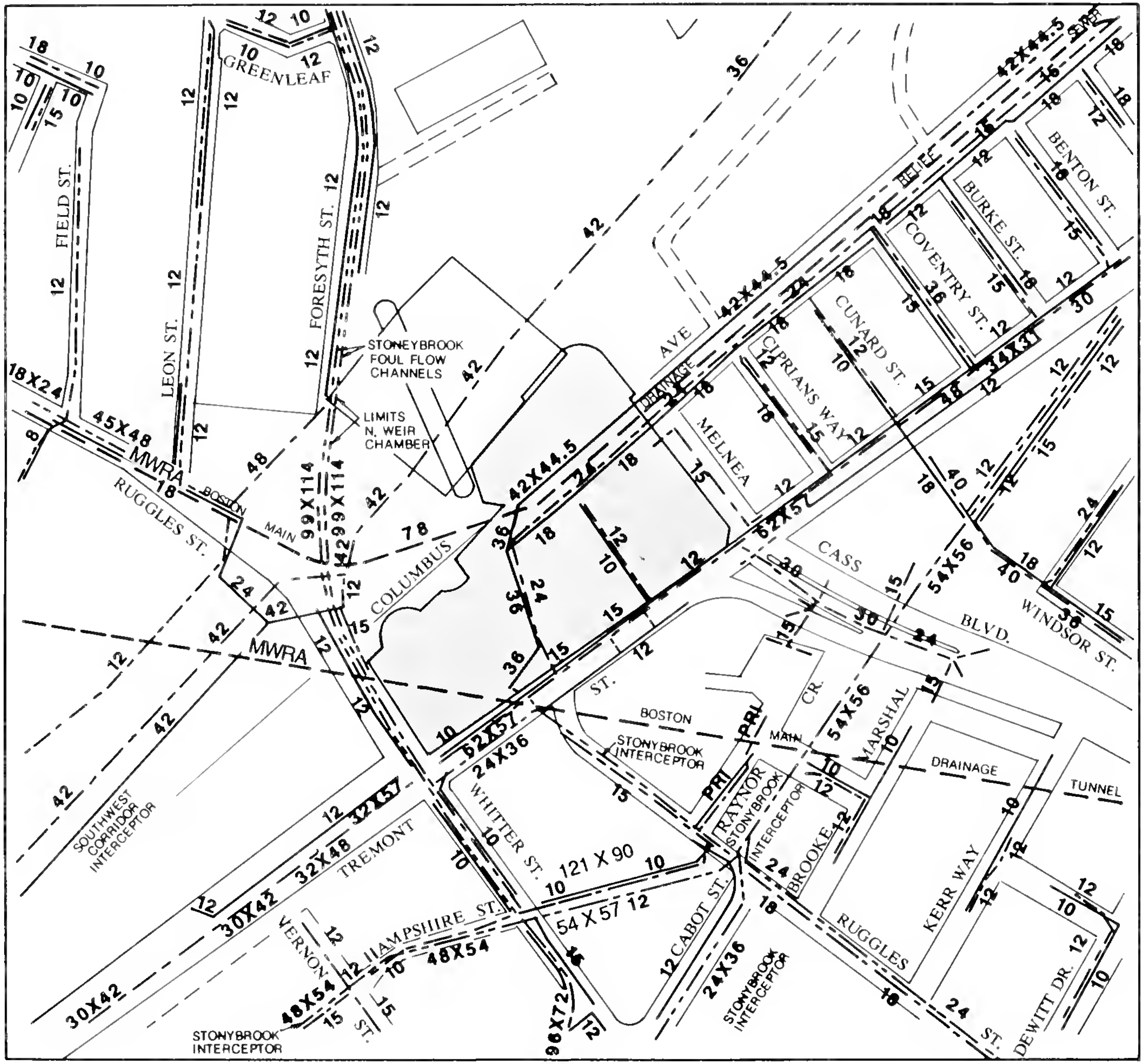


FIGURE II B-3
RUGGLES CENTER PROJECT AREA - SEWERAGE SYSTEM

NOTES:

1. SHADED AREA DESIGNATES LIMITS OF PROJECT DEVELOPMENT FOR THE RUGGLES CENTER.

2. NUMBER DESIGNATES DIAMETER OR PIPE SIZE IN INCHES.

LEGEND

- COMBINED SEWER
- SANITARY SEWER
- STORM DRAIN
- METRO DISTRICT COMMISSION SEWER

100 0 100 200 300
SCALE IN FEET

sanitary flows will discharge to the 24 inch x 36 inch brick sewer in Ruggles Street, south of Tremont Street, with a capacity of approximately 13 cfs. This sewer connects to the Stony Brook Interceptor at Ruggles and Hampshire Street. The capacity of the Interceptor is in excess of 60 cfs.

Existing capacity is nearly three times the existing demand on the Stony Brook Interceptor. Based on a limited physical inspection, the Stony Brook Interceptor appears to be in good structural condition. Little or no sediment and infiltration problems exist (Metcalf & Eddy, 1985).

Upstream, at Whittier Street and Tremont Street, overflows from the Stony Brook Interceptor are discharged to the Old Stony Brook Conduit and thence to the Stony Brook Foul Flow Channels. Although such overflows are intended to occur only during wet weather conditions, it has been reported that overflows also occur during dry weather at this location. This situation has been attributed to a malfunctioning regulator (Metcalf & Eddy, 1985). The capacity of these conduits is approximately 600 cfs.

The MWRA recently has begun a major upgrading of the Deer Island Treatment Plant, which will increase its capacity to 1,273 mgd and provide secondary treatment to the wastewater. With the completion of this project, scheduled for 1999, dry weather discharges to the Harbor will be eliminated and wet weather discharges will be substantially reduced, resulting in improved water quality.

Peak project-generated sanitary discharges to the Stony Brook Interceptor system of approximately .6 cubic feet per second constitutes less than three percent of the system's current peak flow. Even with these new peak flows, the system would continue to have a high reserve capacity of nearly 40 cfs. The contribution of the site's flows to the downstream facilities, including combined overflows, is thus considered minor. Nevertheless, the project proponent will moderate sewer flows by implementing and using water conserving facilities and practices required by the Massachusetts Plumbing Code and other design elements.

During high volume wet weather flows, when branch sewers carrying flows to the Stoney Brook interceptor exceed the interceptors carrying capacity, flows overflow into the Old Stoney Brook Conduit.

Table II B-6 Ruggles Center Sewer Capacity Evaluation

Segment MH -MH	Street Name	Segment Size (inches)	Segment Length (feet)	Segment Slope (ft/ft)	Capacity (cfs)
234-231	Columbus Ave Ext.	18	250	0.00348	5.37
231-230	Columbus Ave Ext.	18	160	0.01606	11.55
230-258	Plaza Area	36	200	0.0055	42.87
258-257	Tremont St.	36	100	0.005	40.87
257-134	Tremont St.	36	80	0.0125	64.63
134-136*	Ruggles St.	24 X 36	440	0.00182	13.78
136-RE137*	Ruggles St.	24 X 36	50	0.0076	28.33
RE177-294*	Stony Brook Inter.	54 X 56	410	0.00136	39.51
294-295*	Stony Brook Inter.	54 X 56	440	0.00136	39.51
295-296*	Stony Brook Inter.	54 X 56	435	0.00149	40.89
296-298*	Stony Brook Inter.	54 X 56	180	0.00066	27.94
298-302*	Stony Brook Inter.	54 X 56	270	0.00192	46.03
302-308*	Stony Brook/ Boston Main Inter.	54 X 56	415	0.01019	106.64
256-WK254	Tremont St.	10	210	0.02619	3.07

NOTES:

* Combined sewer segments.

1. Manhole identification numbers, sewer sizes, invert elevations and segment lengths taken from BWSC Wastewater System Map, No. 201.

2. Capacity calculated using Mannings equation with a coefficient of roughness of 0.015 (fair condition brick or concrete).

3. Area determined by Area = 0.510 (Depth)squared.

The Old Stoney Brook Conduit carries this overflow volume to the Muddy River Gatehouse to meet the Foul Flow Channels thence forward to the Boston Marginal Conduit.

The BMC, which is an MWRA facility, begins at the gatehouse adjacent to the Muddy River, west of Massachusetts Avenue and extends along the Charles River Basin, generally along the alignment of Storrow Drive. The BMC collects excess wet weather overflows from combined sewer systems which previously entered the Charles River. These flows are carried by the BMC along the Storrow Drive alignment to north of Leverett Circle where it turns and extends under the Charles River to the Charles River Estuary Pollution Control Facility (CREPCF) near the left bank of the river. This facility also receives excess flows from the Cambridge Marginal Conduit and other combined sewer systems in Cambridge, Charlestown and Somerville. The CREPCF stores the excess wet weather flows in large underground tanks. A pumping station within the facility pumps these flows into the North Metropolitan System at a controlled rate. When flows are greater than the pump rate and the holding capacity of the facility is reached, a large pumping station within the facility is activated and the excess flows are discharged through a force main to discharge points downstream of the Charles River Dam. The discharge from the smaller pump station flows by gravity to the Alford Street pump station where it is lifted and flows by way of the Chelsea Creek Headworks and the North Metropolitan Relief Tunnel to the Deer Island Wastewater Treatment facility.

The BMC is designed to overflow through structures located in the Charles River Basin during extreme wet weather flows. MWRA personnel have stated that their ongoing combined sewer overflow (CSO) study has shown no incidents of overflow from any of the structures other than the one located directly at the Muddy River. Their studies have not yet proceeded far enough to determine whether the flows at the location are overflows from the BMC or direct discharge of Muddy River flows into the Charles River.

Electric Power Capacity

The capacity to generate power exists at Boston Edison Company's three plants: Mystic Station in Everett (oil and gas); the New Boston Station in South Boston (oil and gas); and the Pilgrim Nuclear Power Plant in Plymouth. Power is supplied to the Boston vicinity via 115 kV and the 345 kV transmission systems. Bulk substations transform this power for 13.8 kV and 4 kV distribution

systems. Additional power may be drawn from the Northeast power grid. Grid power is produced by oil, gas, coal, nuclear, and hydroelectric stations. The total peak connected capacity of the Mystic, South Boston, and Pilgrim power plants is 2,823 megawatts.

The area in the vicinity of Ruggles Center is serviced by the Boston Edison Company Substation No. 318, located at 73 West Canton St., in the South End. This substation currently transforms three 13.8 kV lines at 7,000 kVA each to thirteen 4 kV lines at 3,200 to 4,000 kVA each. These radially supply the vicinity with single-phase, three-wire, 120V/240V service (Silvia, 1986).

During the past decade, the project area has experienced increased housing renovations. The existing oil, gas, and coal heating equipment often has been replaced with electric heating systems. A tenfold increase in power requirements for these homes has required continuous upgrading of the local distribution system.

To maintain sufficient excess capacity and accommodate anticipated growth in electrical demand, increases in capacity have been programmed by the Boston Edison Company. To incorporate some redundancy into the radial distribution system, it is currently being converted to a three phase, four-wire, 120V/208V service. This will allow for future conversion to a networked grid system (such as in downtown Boston) where the failure of a given transformer is absorbed by other transformers without affecting customers.

Increases in capacity will be achieved through the addition of one 13.8 kV feed line from Substation 323 and five 13.8 kV feed lines (7,000 kVA each) from Substation 52 to Substation 318. A new substation is also being planned to support continuing development in this area.

The projected peak electric loads for Ruggles Center are expected to generate an additional demand of 6.7 megawatts. This increase in demand represents a small increase in peak demand and is well within the system capacity of 2,823 Mw. The project proponent, nonetheless, will install energy efficient equipment and fixtures to minimize electric demand.

Backup capacity will conform to code requirements. On-site emergency generators will be installed to assure life safety in the buildings.

The degree to which upgrading is necessary and the schedule for implementation of these improvements will be determined by the Boston Edison Company. Boston Edison will base these on the requirements and implementation schedules for area projects and projected increases in demand due to residential conversions.

Gas Distribution and Supply

Natural gas is supplied to the Boston Gas Company distribution network through three plants: the Everett Plant, the Commercial Point Plant in Dorchester, and the Wellesley Meter Station. In the project vicinity, gas is distributed by gas mains located in the public ways adjacent to the site as follows:

Street	Size	Installation Date
Tremont Street	12 inch	1982
Ruggles Street	12 inch	1985
Melnea Cass Blvd	8 inch	1979

Supplies of natural gas appear to be adequate and sufficient. Final determination on the specific adequacy of the local distribution network will be made by Boston Gas at the time of application. The level of projected gas usage by the project is not anticipated to adversely impact either the gas supply or distribution systems. All modifications to the gas distribution system that may be required will be done by the Boston Gas Company, subject to reimbursement by the developer.

Mitigation Measures

Conservation

Energy Efficient Appliances

Ruggles Center will use energy efficient appliances and fixtures that meet or exceed the requirements set by the Boston Redevelopment Authority (BRA) and the Massachusetts Building Code. These will limit the increased demand on energy supplies and distribution networks.

Strict Observance of Water Conservation

The amount of additional water required to satisfy the proposed development will be kept to the minimum amount possible. To assure this, Ruggles Center will comply strictly with the Commonwealth of Massachusetts Plumbing Code with respect to low flow plumbing fixtures. In addition, the project design will incorporate the latest possible facilities to ensure efficient use of water in areas such as: interior and exterior irrigation devices, use of fountains, water coolers and water flow devices.

Sanitary Flows

Reduction of Sewer Overflows

The MWRA is presently preparing a study of the combined sewer overflow (CSO) system that will make recommendations on methods for eliminating or minimizing the impact of CSO's on the water quality of receiving waters. A draft version of this report is due to be made available in January, 1990 with the final report filed in mid-1990. Until such time as the recommendations of that report are known, both the MWRA and BWSC have agreed that the best available method of reducing the CSO impact on receiving waters is to minimize the volume of sanitary flow exposed to overflow conditions by separation of dry and wet weather flows and by the use of water conservation measures to reduce the volume of sanitary flows generated.

The sewer system servicing the proposed site area was reconstructed, to a large extent, during the Southwest Corridor Project construction. The local systems to which the project flows will be discharged have been separated. Ruggles Center will moderate sewer flows by implementing and using water conserving facilities and practices required by the Massachusetts Plumbing Code and other design elements.

The developer will be preparing a water and sewer site plan during the design phase which will detail the physical relationship of project elements to existing water and sewer facilities, the project service connections, projected flows at each location and other pertinent design information. These plans will be submitted to both the MWRA and BWSC for approval prior to the issuance of service connection permits by DEP.

Access to Water Mains and Drainage Tunnels

The southwest corner of the site (at the corner of Ruggles and Tremont Streets) is traversed by a 50 foot wide easement. This easement contains the 10 foot wide Boston Main Drainage Tunnel, currently under the jurisdiction of the MWRA. The tunnel, which is located within bedrock approximately 300 feet underground, carries effluent from the Ward Street Headworks to the Deer Island Treatment Plant. The proposed building has been designed to cover this easement at ground level. The developer will coordinate closely with the MWRA on this and all building design which may involve impact on water mains and drainage tunnels.

Where construction over, or adjacent to, sewers, drains or water mains is planned, relocation of or access to these lines for repair and maintenance will be provided by the developer in accordance with the

requirements of and subject to the approval of the appropriate agency, BWSC or MWRA.

C. Visual Quality, Massing, and Shadows

Introduction

The proposed Ruggles Center will be the first commercial development completed along the Southwest Corridor. As such, its impact on the neighborhood is significant and will set the tone for other developments which follow. Already, the design of Ruggles Center has undergone many iterations to better integrate the buildings with the neighborhood and reduce shadow impacts. The Master Plan Design embodies several changes which will have a direct and positive impact on visual quality, massing and shadows. These changes include:

- Reduction in overall developed square footage and building mass;

- A 1 1/2 story reduction in the lowrise portion of Building 3 near the Ruggles Station Park, resulting in reduced morning shadows on the park and playground area;

- Setback from Ruggles Street of upper two floors of the Building 4 facade, especially at the corners, resulting in reduced morning shadows on the Southwest Corridor Park and Ruggles Street.

The sections which follow provide a picture of the existing neighborhood and analyze how Ruggles Center will shape the urban space around Ruggles Street Station.

Visual Character of the Area

The project site is located in an area dominated by the Southwest Corridor mass transit system and the convergence of several wide, heavily traveled streets (Tremont, Columbus Ave., Ruggles, and Melnea Cass). A sense of openness predominates with broad northerly views to the Boston skyline and southwesterly views towards the hills of Roxbury. The buildings in the vicinity are generally less than eight stories in height. The large amount of vacant land contributes to a lack of urban definition in the area.

Figure II C-1, an aerial photo, shows current building and roadway patterns and the Boston skyline in the background. Across Tremont Street is the Whittier Street Housing Project, a four to eight story complex. North of the project, but set back from Tremont Street, is the St. Francis De Sales Church, which has a 3-story base and a steeple rising to approximately 100 feet. The church is an important neighborhood

Figure II C-1
Aerial View of Ruggles Center Site and Environs

landmark. There are vacant redevelopment parcels at the intersections of Whittier Street-Tremont Street and Melnea Cass Boulevard-Tremont Street. The Madison Park High School and Hubert Humphrey Occupational Resource Center complex is the 3 story structure in the immediate right foreground of the photograph.

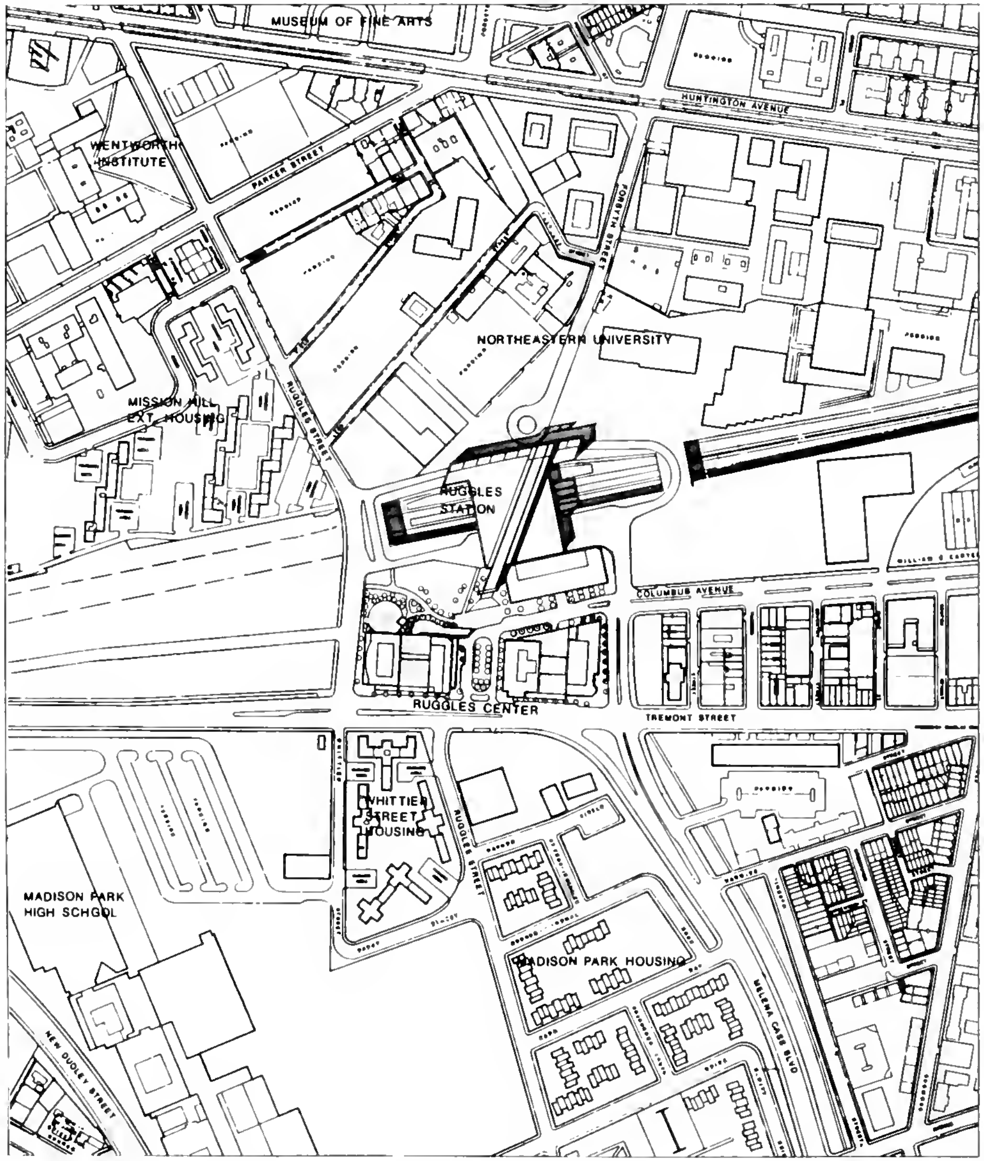
Directly north of the site is Northeastern University and several commercial establishments. Ruggles Street Station, with its low rise canopy spanning the rail lines, links the center of the project site to the Northeastern campus. Most of the campus buildings are four to six stories in height and substantially hidden from view by the Ruggles Street Station and the walls that run along both sides of the tracks. Northeast of the site, along the Southwest Corridor, a 6-level parking garage has been constructed by the university. The area directly adjacent to the garage (Parcel 17X) is currently used for surface parking. Along Tremont Street is a long 8-story apartment building (Roxse Homes).

The Mission Hill Extension public housing project is a development of mid-rise (8-story) apartment buildings located west of Ruggles Center (left foreground of the photograph). The buildings are partially visible from the project site. Directly across from the Ruggles Center parcel at the intersection of Ruggles and Tremont Streets, is Parcel 22, a future site for 4- to 6-story housing. The Southwest Corridor Park is northwest of Parcel 22 adjacent to the transit line.

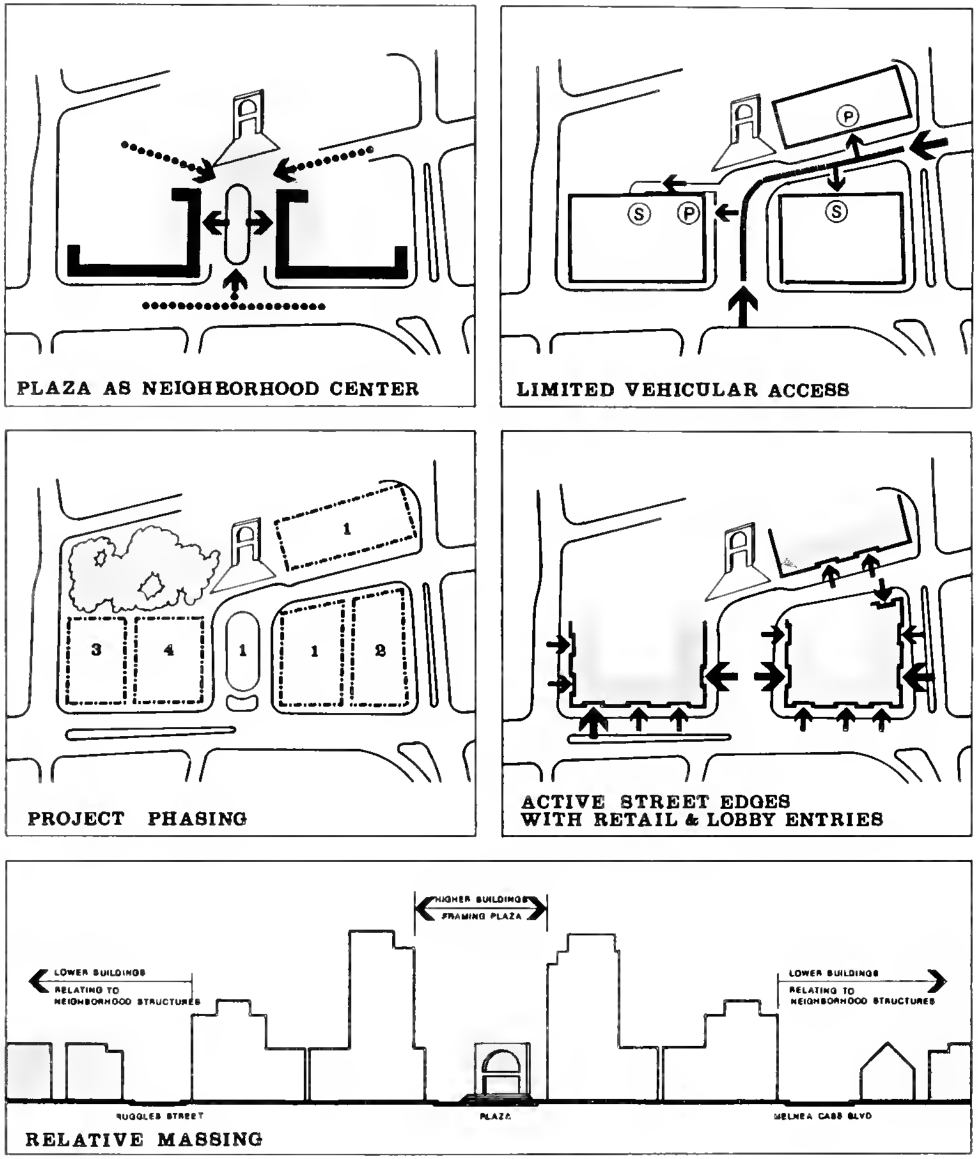
Project Design Principles

The basic design concept of Ruggles Center is the creation of a new center of urban activity. The occurrence of major roadway intersections, direct access to the transit system, close proximity to area institutions and the Southwest Corridor Park system combine to create an excellent opportunity for neighborhood revitalization and new commercial development.

The Master Plan Design proposes the phased construction of a five building complex which relates to the character of the existing neighborhood. Medium height buildings at 9 to 15 stories (approximately 140-195 feet total building height) are proposed with lowrise elements and other massing articulations to relate to nearby structures. The primary organizing element for situating buildings on the site is a central pedestrian plaza connected to the Southwest Corridor Park. The plaza will be on axis with the entry portal at Ruggles Station and will open onto Tremont Street at the other end. This 125 feet wide by 250 feet



NEIGHBORHOOD PLAN



DEVELOPMENT CONCEPTS

URBAN DESIGN PRINCIPLES

Figure II C-2

long plaza will be extensively landscaped and serve as the center of pedestrian activity on the site. Retail stores and office lobbies at ground level will provide multiple points of entry and enliven street edges.

Massing

The height and massing rationale for the Master Plan Design is based on the logic of distributing building bulk that is compatible with buildings in the area. Through the placement of setbacks and other prominent building components, a stepped configuration of individual building elements helps to define the plaza as the 'center of gravity' for the site.

Although higher than other buildings in the area, Ruggles Center is well within the overall height guidelines established for the site by the Boston Redevelopment Authority. The lower building elements and implied building bases were restricted to a lowrise zone (40-70 feet) that provides necessary scaling elements, creates transitions to taller masses and relates to similar components of other buildings in the area. Prominent building components such as rounded corners, setbacks and other massing articulations were conspicuously located to take advantage of key view corridors and corner vantage points.

View Corridors

View corridors, views from distant points and perception from the person-on-the-street point of view were of considerable importance in determining the site layout, massing concept and architectural character for the Master Plan Design. Both the north and south Tremont Street approaches were regarded as primary vantage points for pedestrians and motorists. Buildings were situated next to the property line to address the street in a "traditional Boston" manner and define a street wall where currently none exists. From the Melnea Cass Boulevard approach, the overall scale and character of the proposed project is revealed from an angular view-point which allows for identification of each individual building element. The Melnea Cass Boulevard/Tremont Street intersection was considered for its high visibility and is accentuated with an octagonal massing element at the corner of the first building. Even though Columbus Avenue terminates at the project site, the long view is interrupted by a bend in the street six blocks to the north. However, provision for a fitting visual terminus is realized in the 12-story curved, rear corner of the hotel building. This corner also "marks' the site from vantage points west of the site. Since the entry portal to Ruggles Station has become a visual landmark in the area, it was considered too prominent to be obscured by new buildings. The

Figure II C-3
View From Tremont Street

creation of the linear plaza opening onto Tremont Street allows for direct visual access to the station entry to be maintained.

Architectural Character
Building Materials
Facade Articulation

The Master Plan Design proposes a five-building complex on the project site intended as a multi-phase development. As such, consideration was given to establishing a framework or set of design guidelines which would define the character of each successive building element. Also, since each building would likely be designed by a different architect, the flexibility of these guidelines would allow for individual building statements while maintaining a sense of cohesiveness and a unified whole.

In keeping with the materials of "traditional Boston" buildings and neighboring buildings, the predominant exterior cladding will be brick in various shades and colors. Several buildings will incorporate precast concrete panels at the lower levels for accent purposes and to help define the building bases. Pre-cast concrete will also be used together with brick at upper levels for detailing around windows and accenting wall surfaces. Window units will be a combination of tinted spandrel and vision glass set in painted aluminum frames.

Massing Analysis

To better understand how Ruggles Center will change the visual character of the area, schematic drawings, showing the mass, height and scale of the proposed buildings, were superimposed on photographs of the existing site. Three viewpoints, considered important pedestrian and vehicular approaches, were selected for analysis. See Figure II C-4.

- View A — Tremont Street approaching northeast from Roxbury Crossing.
- View B — Melnea Cass Boulevard looking northwest at Ruggles Center.
- View C — Columbus Avenue approaching from Boston looking west.

The discussion which follows reviews the visual impacts of Ruggles Center from these perspectives.

View A
Tremont Street

Figure II C-5 shows the existing view of the project site taken from the south side of Tremont Street looking east. From this vantage point,

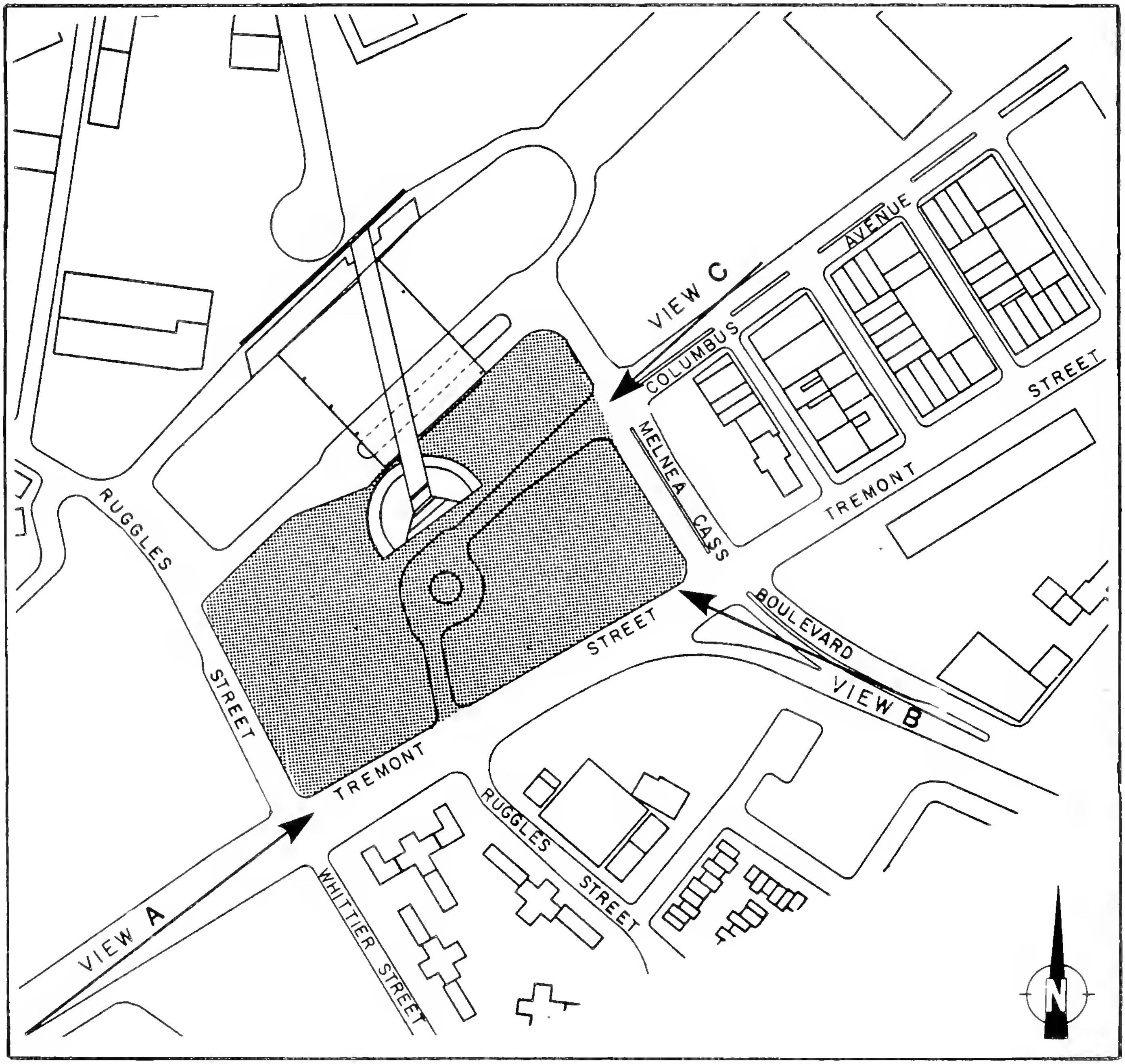


Figure II C-4
Viewing Locations For Visual Analysis

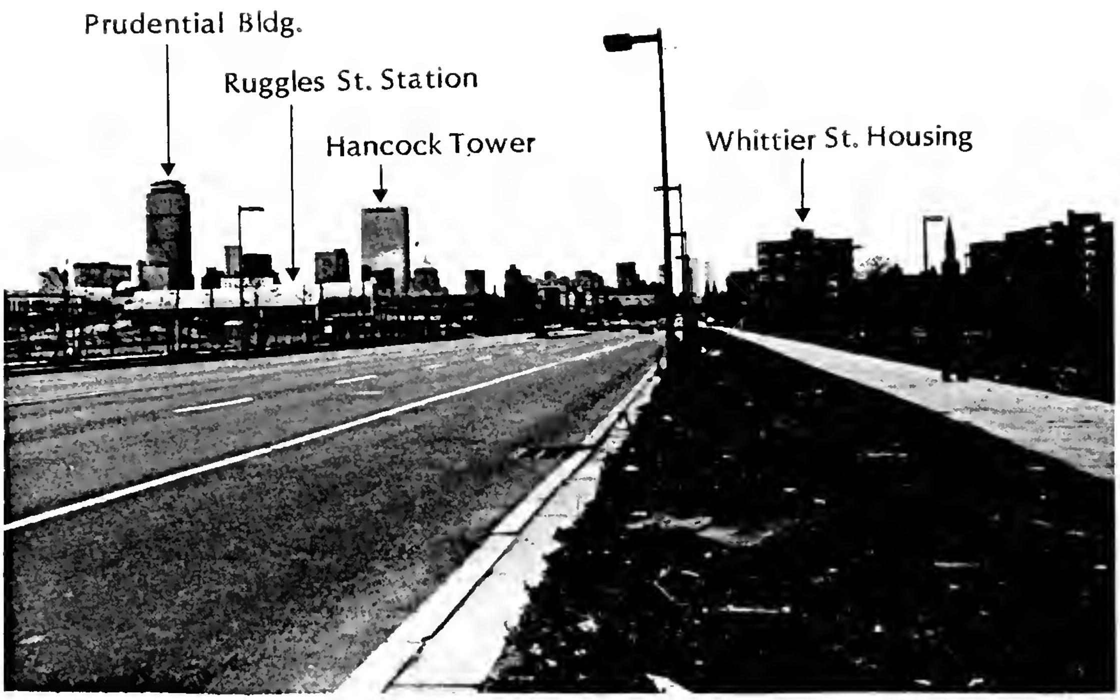


Figure II C-5: View A - Tremont Street: Existing Condition

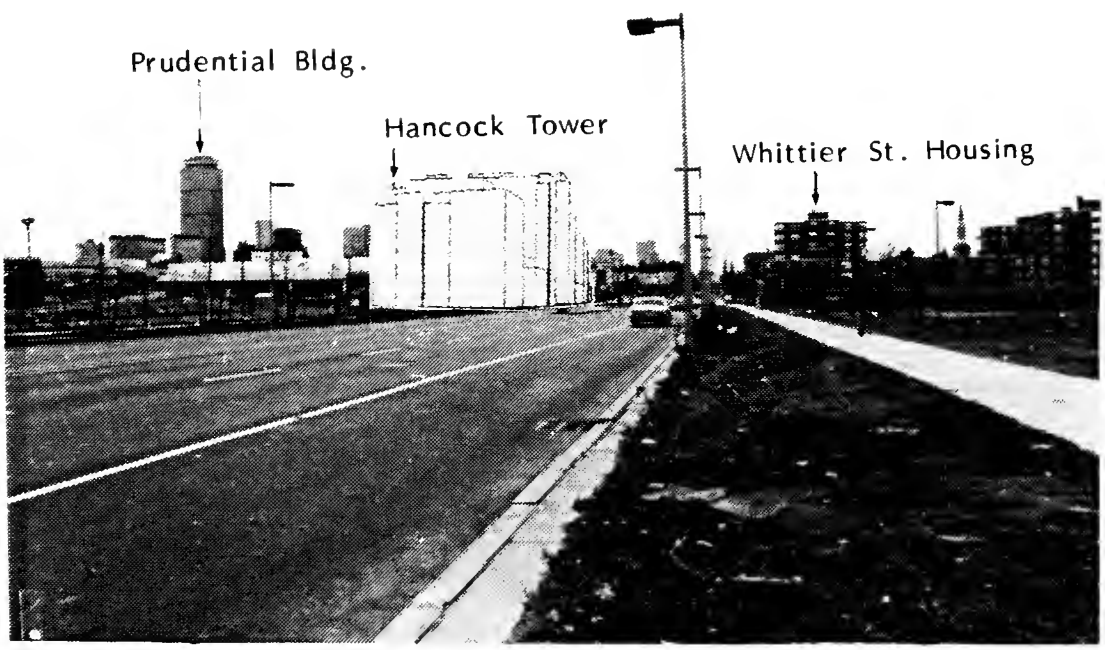


Figure II C-6: View A - Tremont Street: Master Plan Design

the Boston skyline is clearly visible in the background with the Prudential Center Tower (to the left) and the John Hancock Tower (in the center) as the dominant features. The Southwest Corridor Park leading to the Ruggles Street Station is visible in the middle left portion of the photo. Across Tremont Street, the Whittier Street Public Housing project is a dominant feature on the right side of the photo, with the St. Francis De Sales Church spire rising in the background.

In Figure II C-6, Ruggles Center buildings, varying in height from 9- to 15- stories, partially obscure long views to the distant Boston skyline. From this viewpoint, only the Hancock Tower, located in Back Bay, will not be visible from Tremont Street on approach from the southwest. Other visual markers, such as the Prudential Building, Federal Reserve Building, and Financial District, remain in view and give orientation clues from ground-level. The varied height of the buildings as they front along Tremont Street and the prominent massing gestures along the south face of the 9-story building at Ruggles Street (large curved setback at top of building and 2-story arcade) combine to relate Ruggles Center to nearby existing buildings and future lowrise development in the area. The existing Tremont Street view corridor to downtown will be enhanced with the addition of the "street wall" that is formed by the Ruggles Center buildings.

View B
Melnea Cass Blvd.

This view is taken from the center traffic island of Melnea Cass Boulevard looking northwest toward the project site. In the photograph of existing conditions (Figure II C-7), the Ruggles Street Station concourse and south entry area are clearly evident. The entry is a major destination point which is marked by a large portal to the station. Existing street trees on either side of the roadway screen views to the Mission Hill Extension Housing on the left of the photo and St. Cyprian's Church on the right of the photo.

Because Melnea Cass Boulevard is used as a principal approach to the new Ruggles Center, this view provides the primary vantage point to see the project in its entirety. Figure II C-8 shows that the apparent mass of the buildings is reduced by the varying heights of individual building elements (varying from 140 to 195 feet). Pedestrians and motorists will be able to discern the hierarchy of the buildings and see the organizational layout of buildings stepping up to frame the public plaza. Distinct architectural and massing elements such as the articulated corner of the Tremont/Melnea Cass 9-story building and the setbacks at building tops signify the importance of this approach. From

Figure II C-7: View B - Melnea Cass Boulevard: Existing Condition

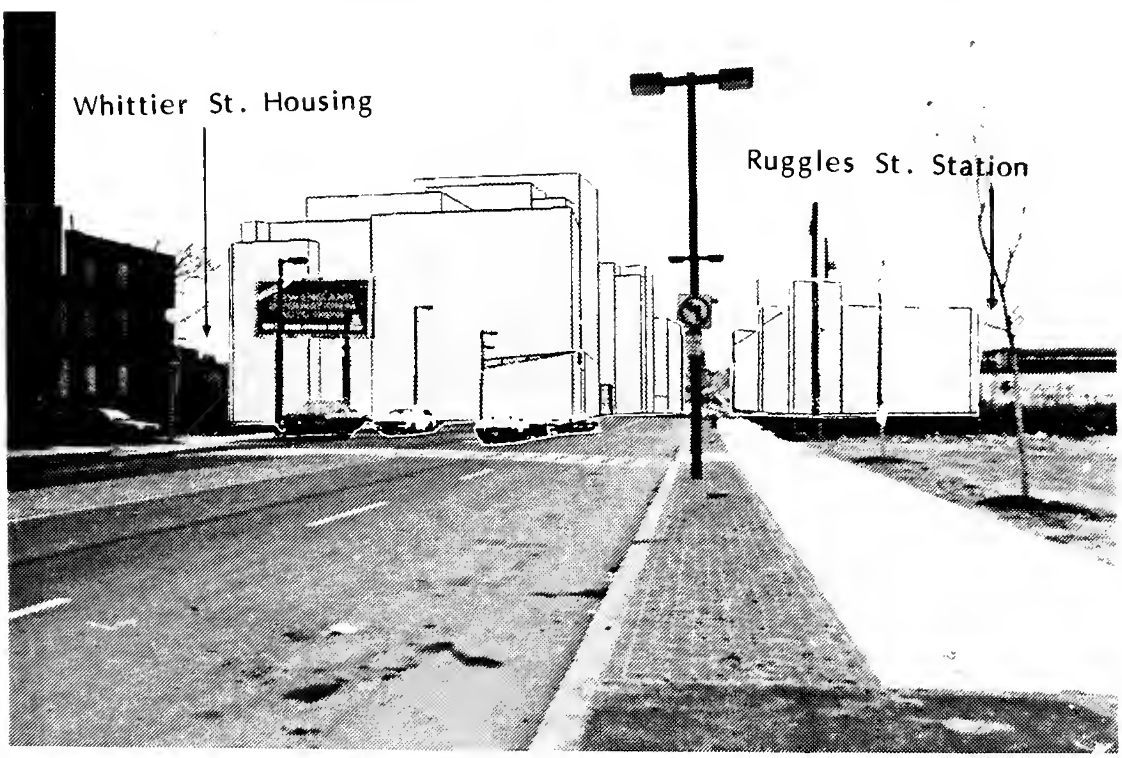


Figure II C-8: View B - Melnea Cass Boulevard: Master Plan Design

Figure II C-9: View C - Columbus Avenue: Existing Condition

Figure II C-10: View C - Columbus Avenue: Master Plan Design

this view, the buildings will completely obscure visual access to the main entry of Ruggles Station.

View C Columbus Avenue

This view is taken from the north side of Columbus Avenue looking west toward the project site. From this location, even under existing conditions, distant views are not well defined. (See Figure II C-9.) The Ruggles Street Station is clearly evident in the right of the photo. The left foreground shows the edges of existing 3- to 4- story brick structures which are typical of this area. The right foreground is dominated by the street improvements and sidewalk area adjacent to Northeastern University parking lots.

From Columbus Avenue, the Master Plan Design establishes a strong sense of street enclosure or "street wall" through building mass and the use of parallel buildings facades that vary in height. The 12-story, curved rear corner of the hotel building becomes a focal point in the view allowing more distant views of the Southwest Corridor Park to serve as a backdrop. Ruggles Street Station is mostly obscured from this vantage point. (See Figure II C-10.)

Shadow Analysis

To determine the net new shadows generated by the proposed Master Plan Design, the shadow impact of all buildings in Ruggles Center was compared to shadows which are currently cast by existing buildings in the area of the project site. This comparison was made for shadows cast at 9 AM, 12 Noon and 3 PM on the following dates: March 21, June 21, September 21 and December 21. These dates represent the winter solstice when the sun is the lowest and the shadows greatest; the spring and autumn equinoxes and the summer solstice when the sun is highest and the shadows minimized. These dates bracket the extremes of the sun's movement.

The net new shadow is defined as the area previously not in shadow that would become shaded as a result of the height and massing characteristics of the proposed Master Plan. Each of the accompanying diagrams shows the outline of the shadows produced by the proposed buildings, and within the area of shadow, differentiates between existing shadows (light grey shading) and net new shadows (darker grey shading). Building footprints are shown in solid black. Only existing shadow conditions that fall within the shadow range of the proposed buildings are shown; other buildings are too far away to have a shadow impact. Consistent with established practice, the ground plane shadows

focus on conditions at the ground and street levels and are not intended to address shadows which fall upon the sides of buildings. The shadow effect of the Master Plan Design on areas and streets surrounding the project site can be described as follows.

Ruggles Street Station

The South entrance to the station will receive sun during afternoon periods throughout the year, although during the fall and winter, morning shadows extend well into the afternoon. Train waiting platforms will not be affected significantly by new shadows. Bus platforms not covered by the station roof will receive primarily morning shadow. At the North entrance to the station, no new shadow will be created.

Southwest Corridor Park

The Southwest Corridor Park, situated west of the site across Ruggles Street, is not affected by Ruggles Center, except during the early morning between March and December when a small area, at the eastern edge of the park bordering Ruggles Street, is in shade.

Ruggles Street Station Park

The Ruggles Street Station Park is the large open area between the station structure and Ruggles Street. The park is in almost full sunlight midday and in the afternoon during the spring and summer when it is likely to have the greatest use. In the winter and fall, afternoon shadows are present until the 3:00 PM observation point. The park is covered by morning shadows during all but the summer months.

Ruggles Center Plaza

The Ruggles Center Plaza will be in partial shadow in the early morning throughout the year, with the least amount of morning shadow falling during the winter. The plaza will be in full sun by late morning in winter and in spring, and by noon in summer and fall, when lunchtime use of the space is expected to be most frequent. By mid-afternoon, the Plaza will be in shadow throughout the year, but will receive some later afternoon sun, especially during the summer.

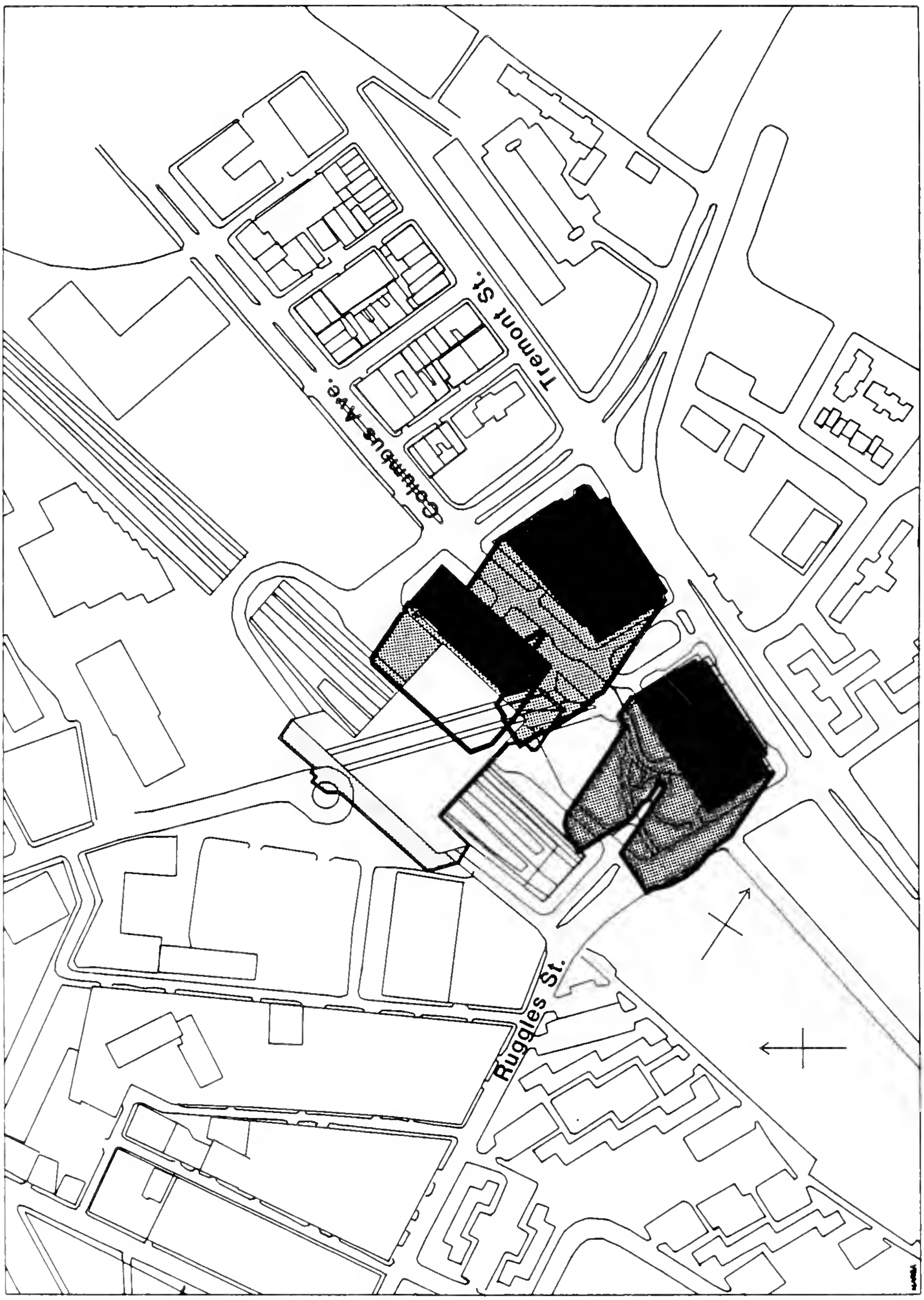
St. Cyprian's Church Open Space

The open space west of St. Cyprian's Church will receive afternoon shadows throughout the year, although during the summer, these will occur only after 3 PM. Mornings in this location will be shadow-free.

Summary

As detailed above and in the accompanying shadow diagrams, the proposed Master Plan massing will introduce a net increase in shadows as is inevitable when new buildings are placed in the middle of a previously open area. For the key location, Ruggles Street Station, new shadows will occur primarily in the morning at the South entrance

and bus platforms. Shadow impact on the Southwest Corridor Park is minimal and limited to a very small portion at its eastern end. Except during summer months, considerable new morning shadow will be cast on the Ruggles Station Park. Afternoon shadows occur primarily in the winter and are noticeably reduced during the spring and fall. It should be noted that, by providing a space between the pairs of proposed buildings, a corridor of sunlight is maintained during those times of the day and year when building shadows do not overlap.



Existing Shadows

Net New Shadows

Outline of Project Shadow

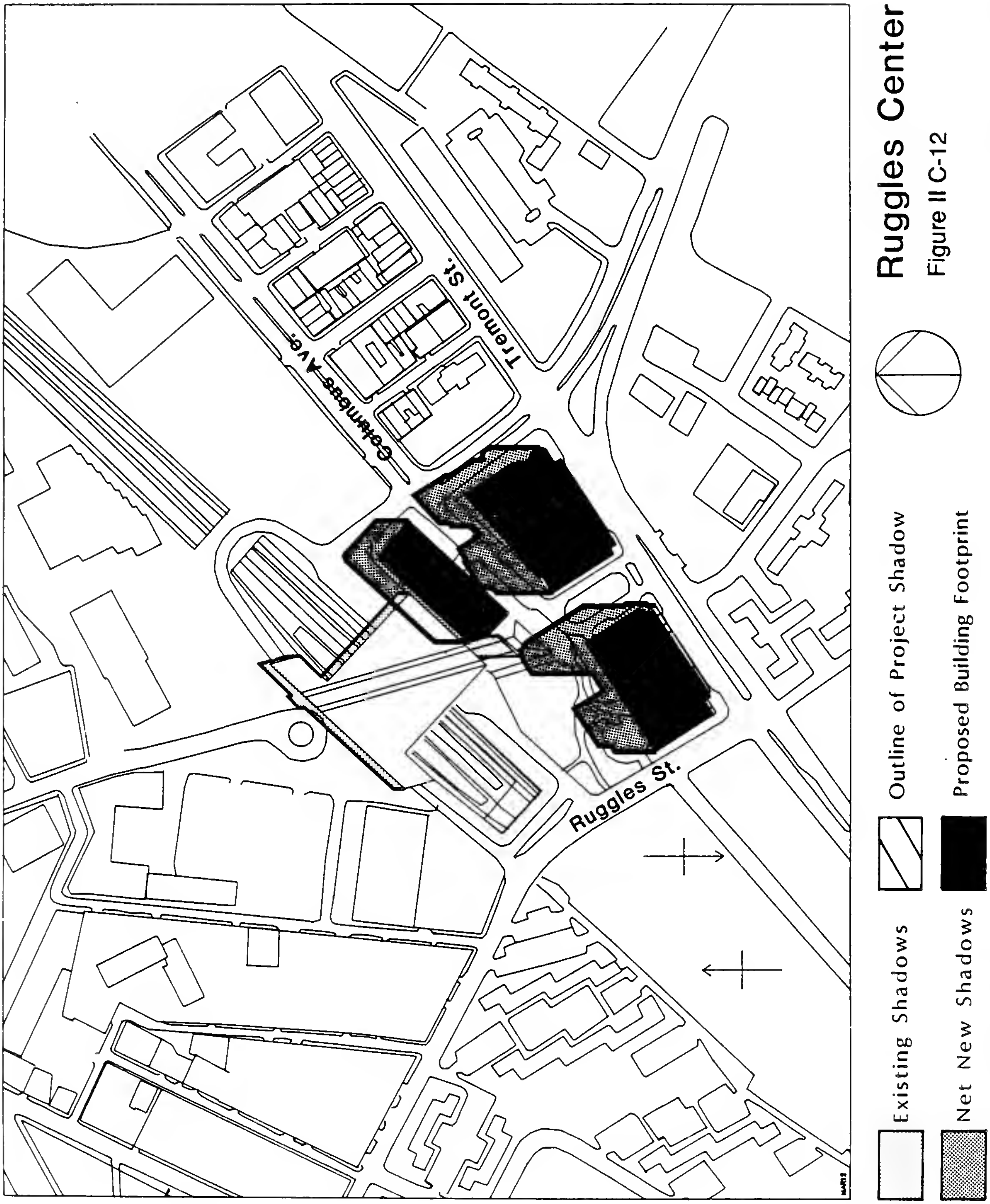
Proposed Building Footprint

Ruggles Center

Figure II C-11

Shadow Studies/Master Plan Design

(March 21, 9 AM)

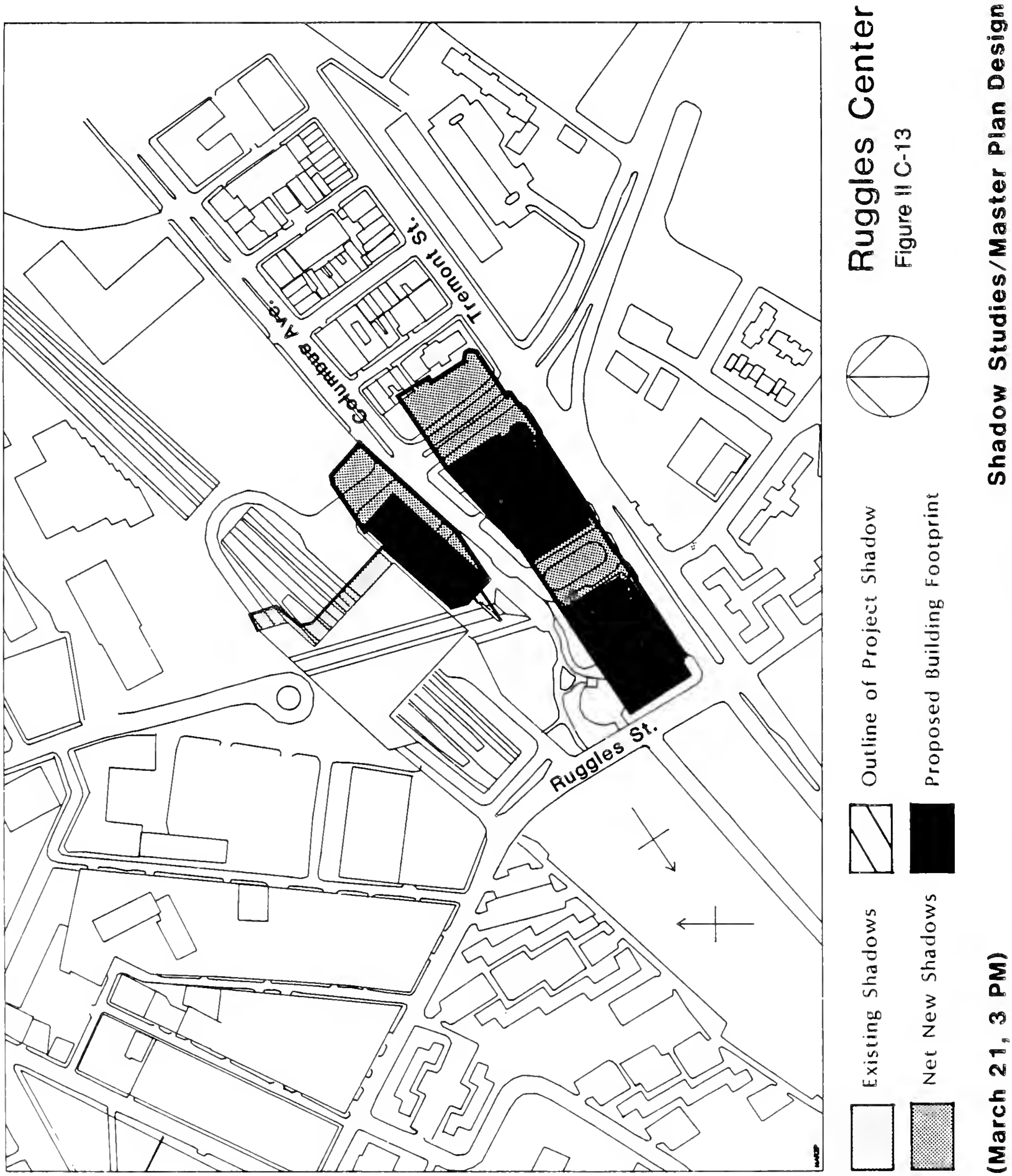


Ruggles Center

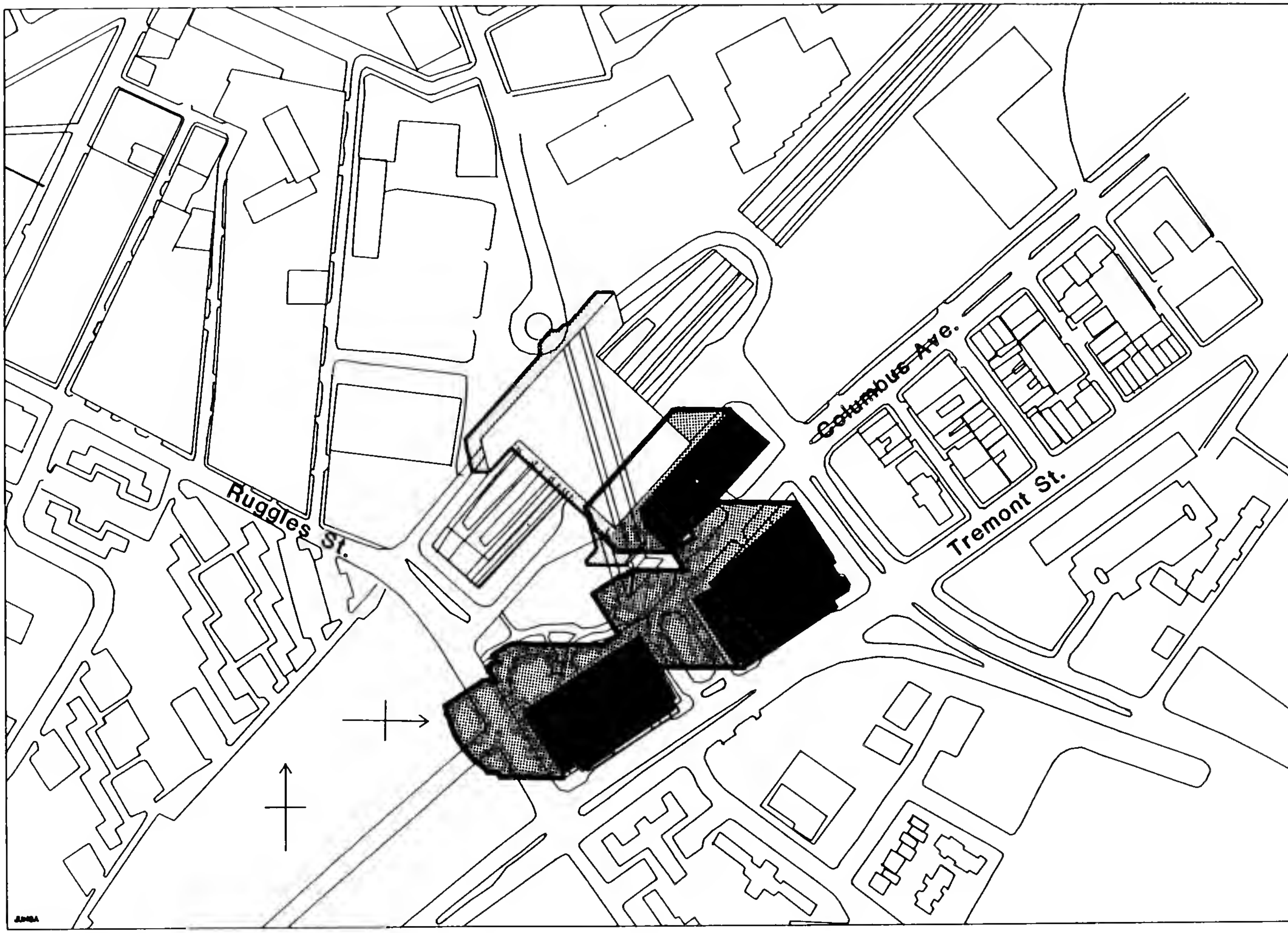
Figure II C-12

Shadow Studies/Master Plan Design

(March 21, Noon)



Ruggles Center
Figure II C-13



Existing Shadows

Net New Shadows

Outline of Project Shadow

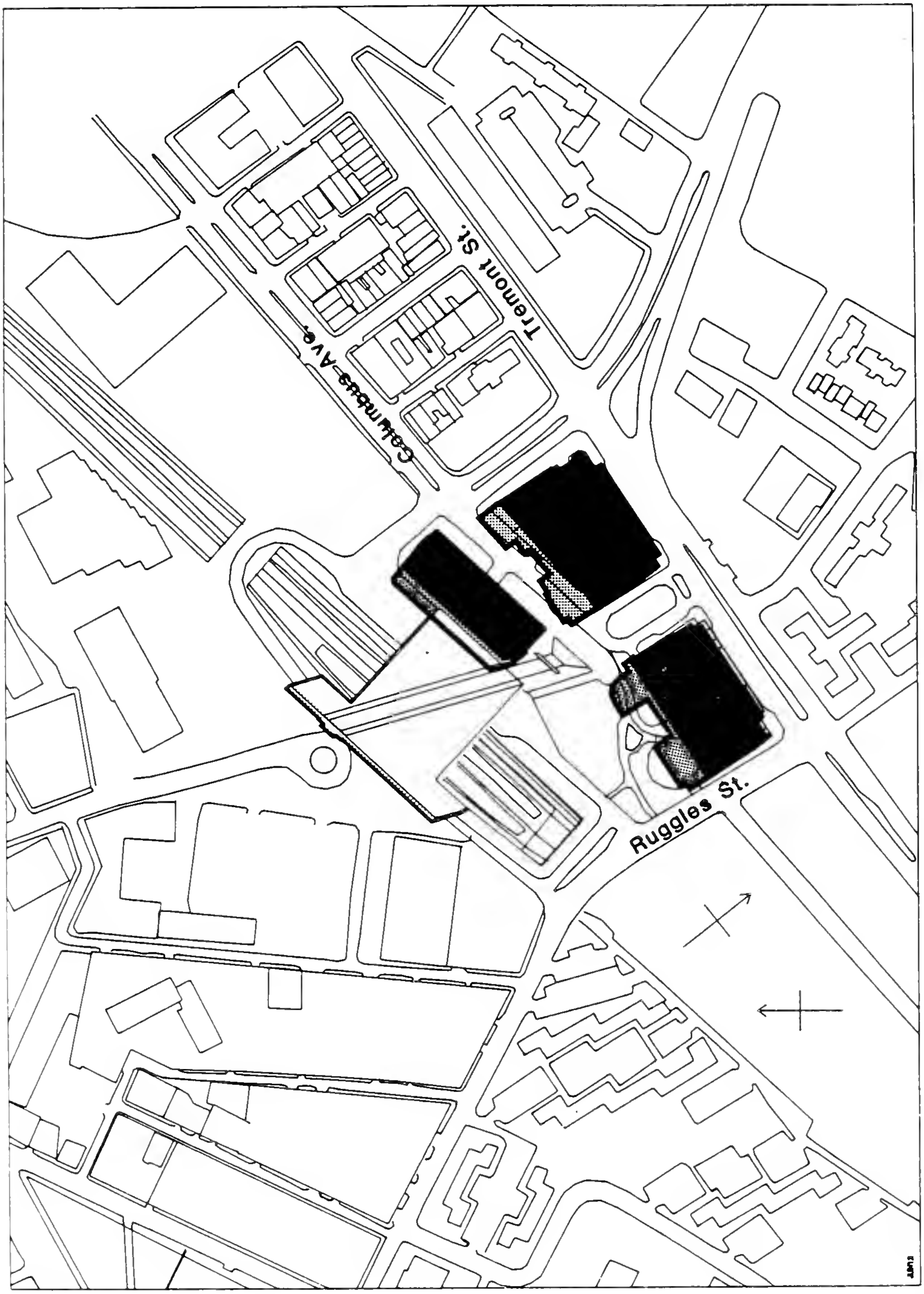
Proposed Building Footprint

Ruggles Center

Figure II C-14

(June 21, 9 AM)

Shadow Studies/Master Plan Design



Existing Shadows

Net New Shadows

Outline of Project Shadow

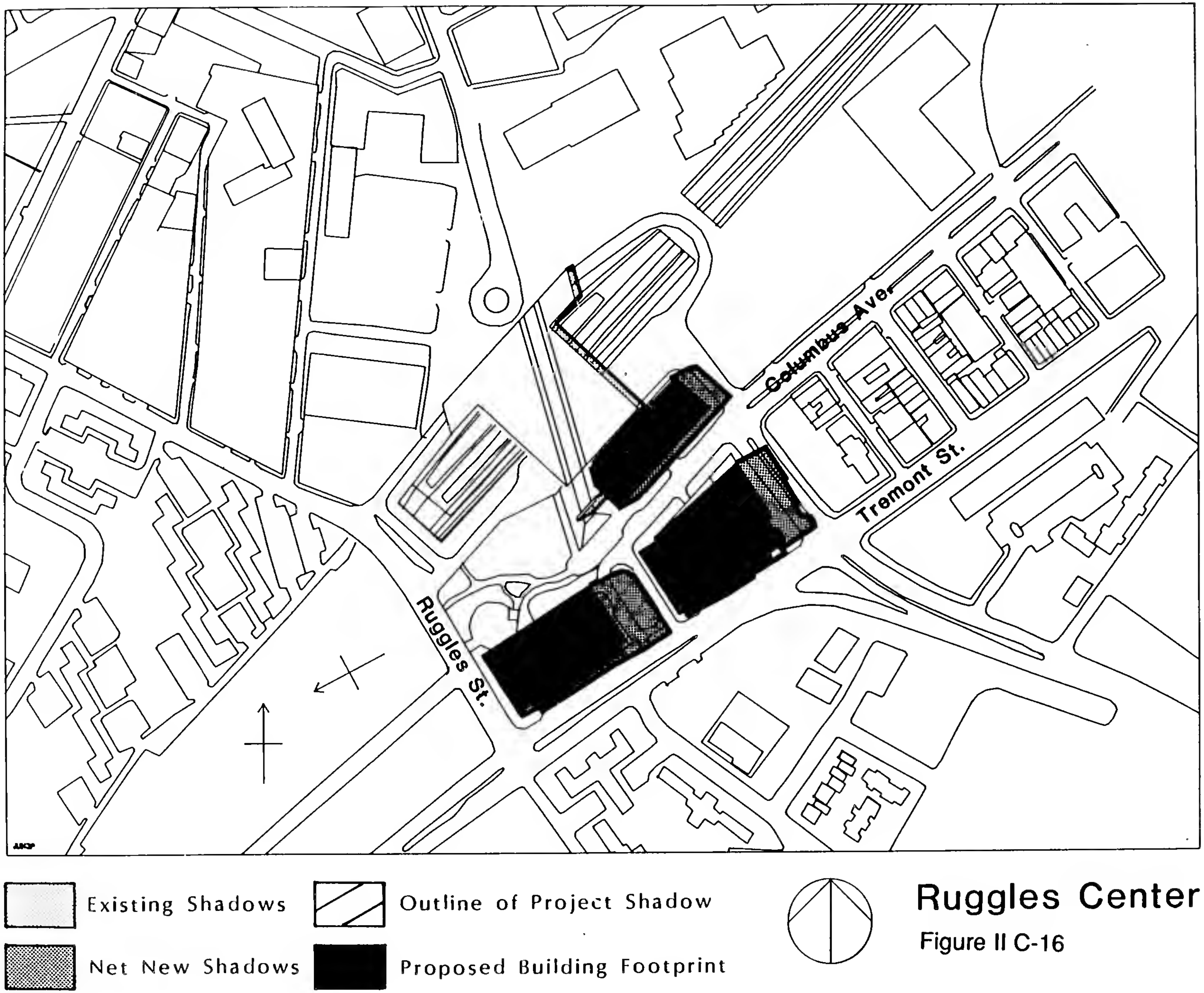
Proposed Building Footprint

Ruggles Center

Figure II C-15

Shadow Studies/Master Plan Design

(June 21, Noon)

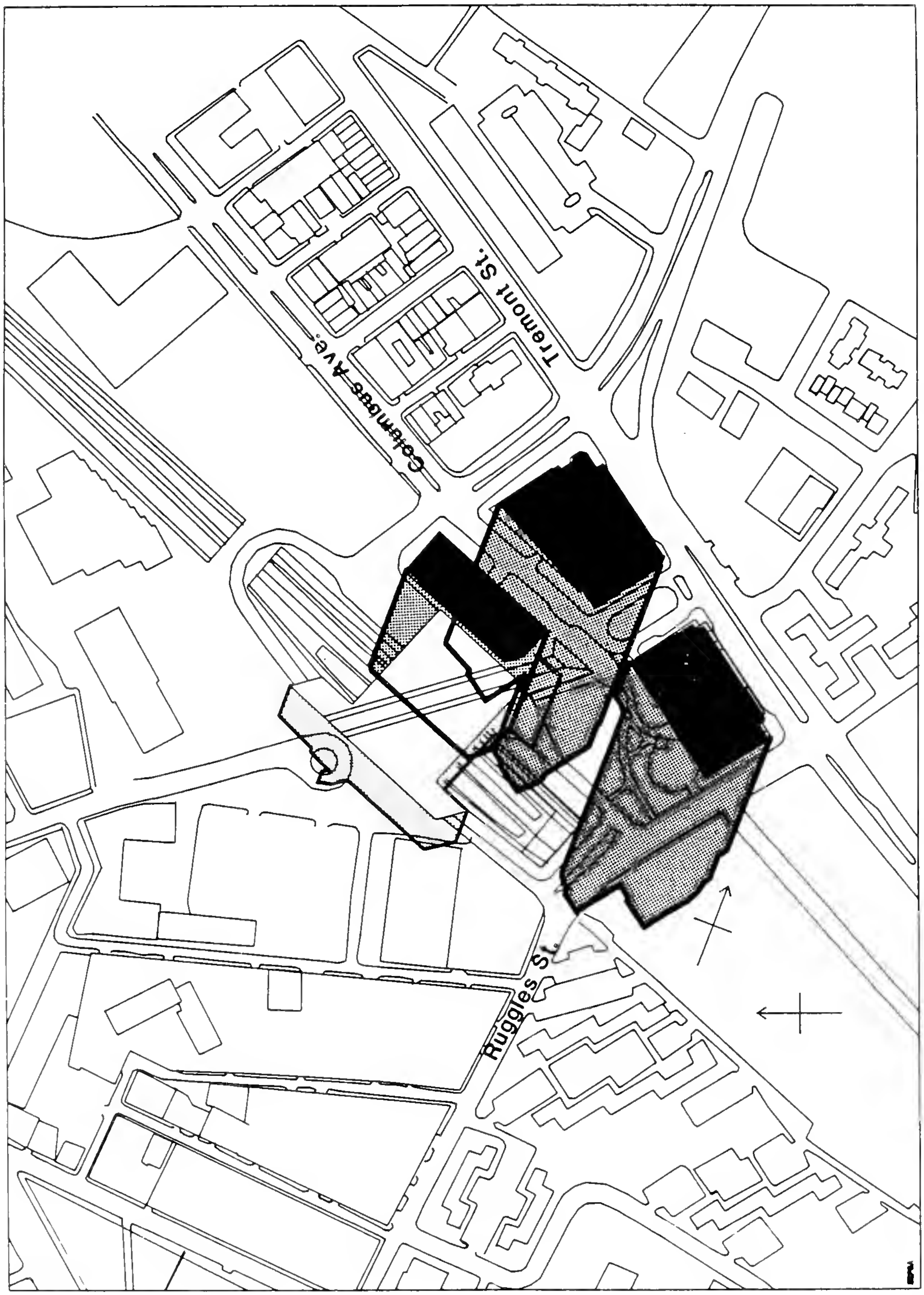


Ruggles Center

Figure II C-16

(June 21, 3 PM)

Shadow Studies/Master Plan Design



Ruggles Center
Figure II C-17

Shadow Studies/Master Plan Design

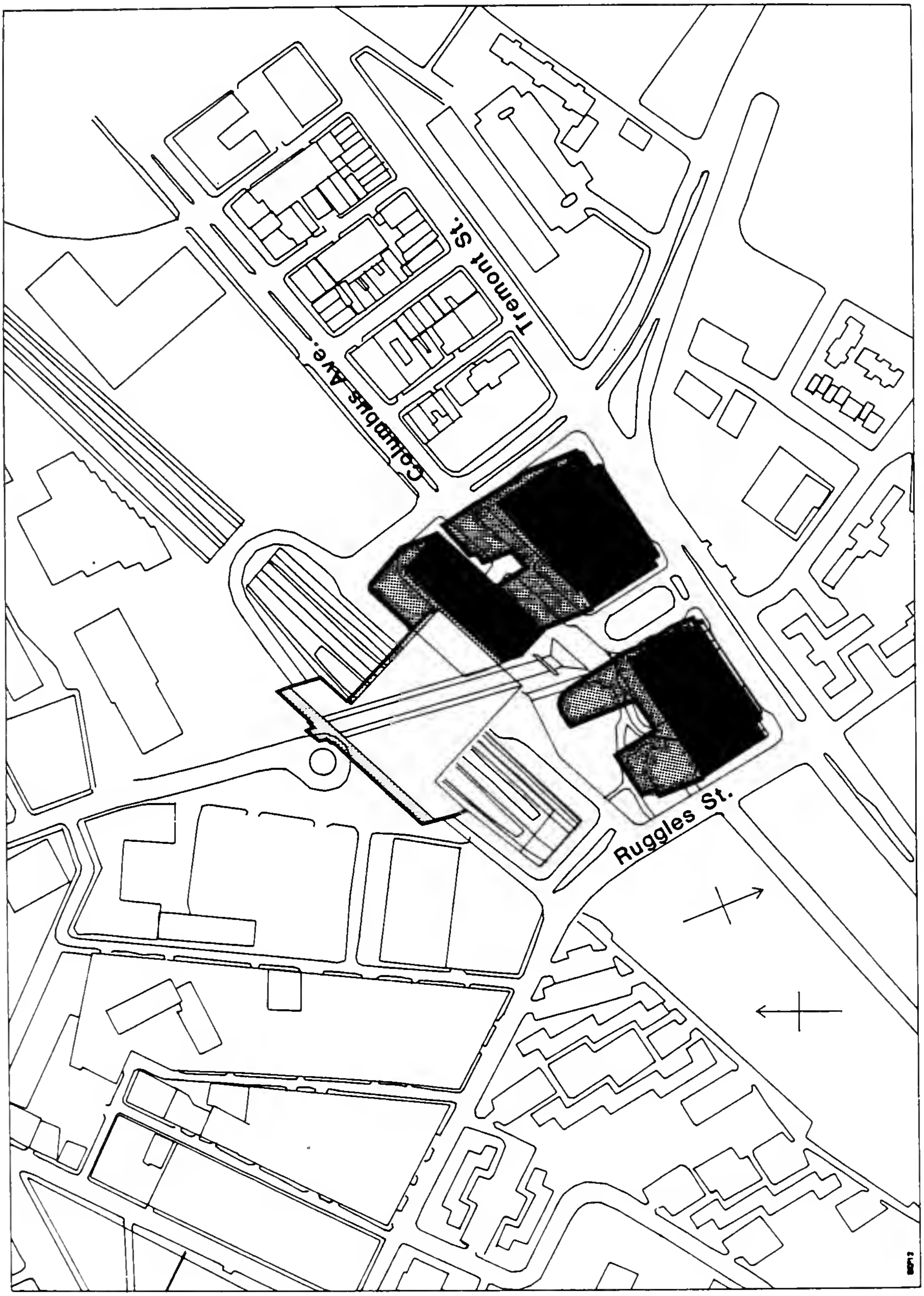
Existing Shadows

Net New Shadows

Outline of Project Shadow

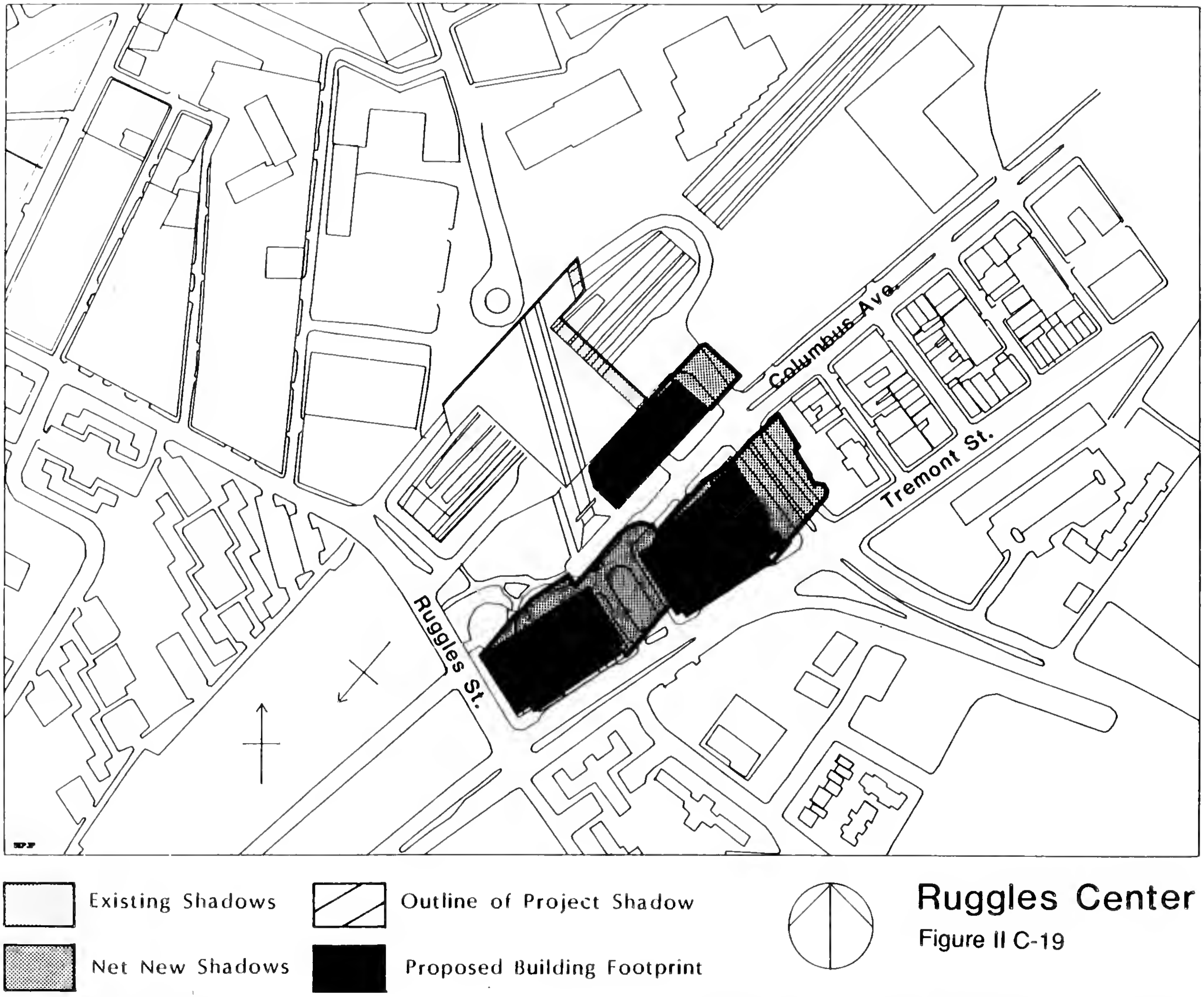
Proposed Building Footprint

(Sep. 21, 9 AM)



Ruggles Center
Figure II C-18

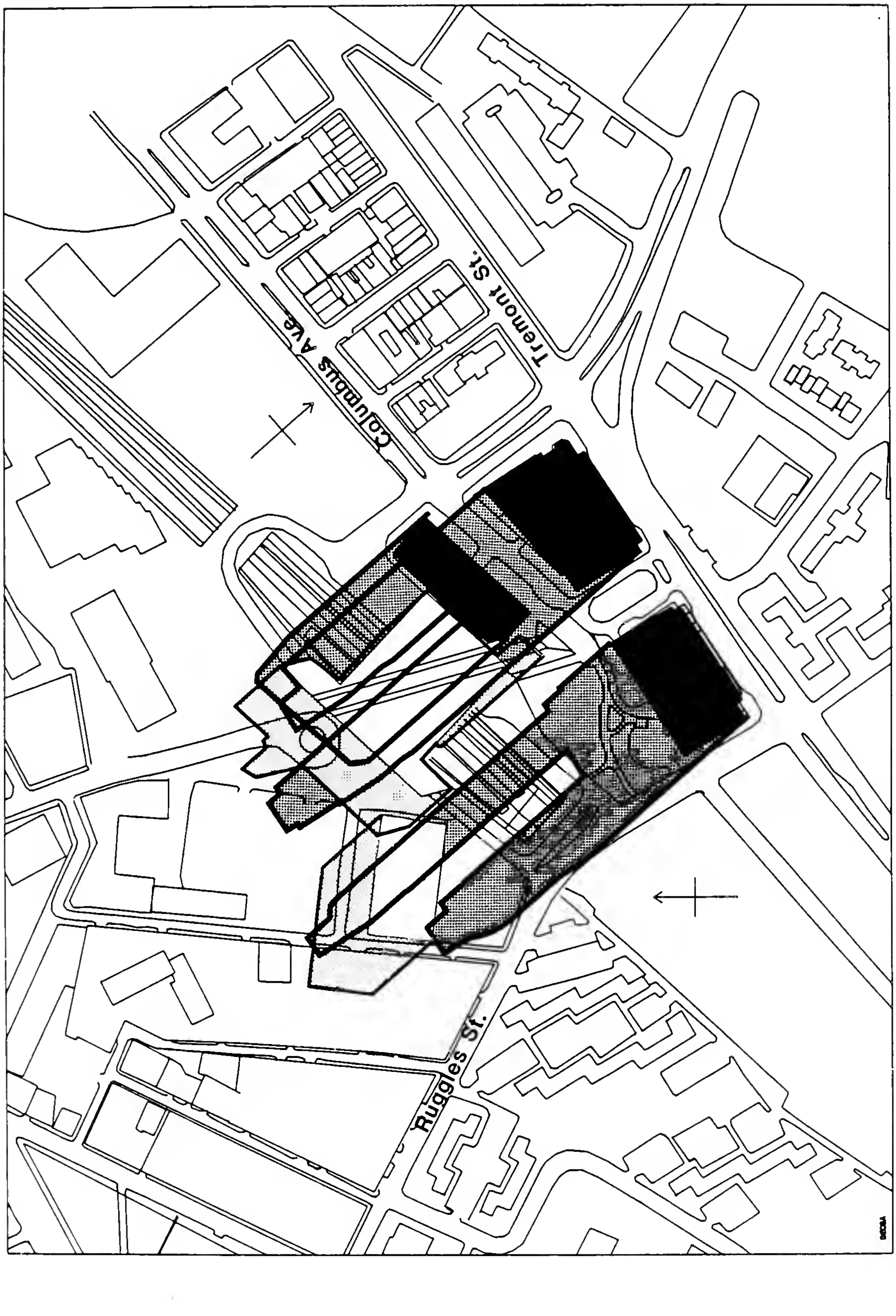
Shadow Studies/Master Plan Design
(Sep. 21, Noon)



Ruggles Center
Figure II C-19

(Sep. 21, 3 PM)

Shadow Studies/Master Plan Design



Existing Shadows

Net New Shadows

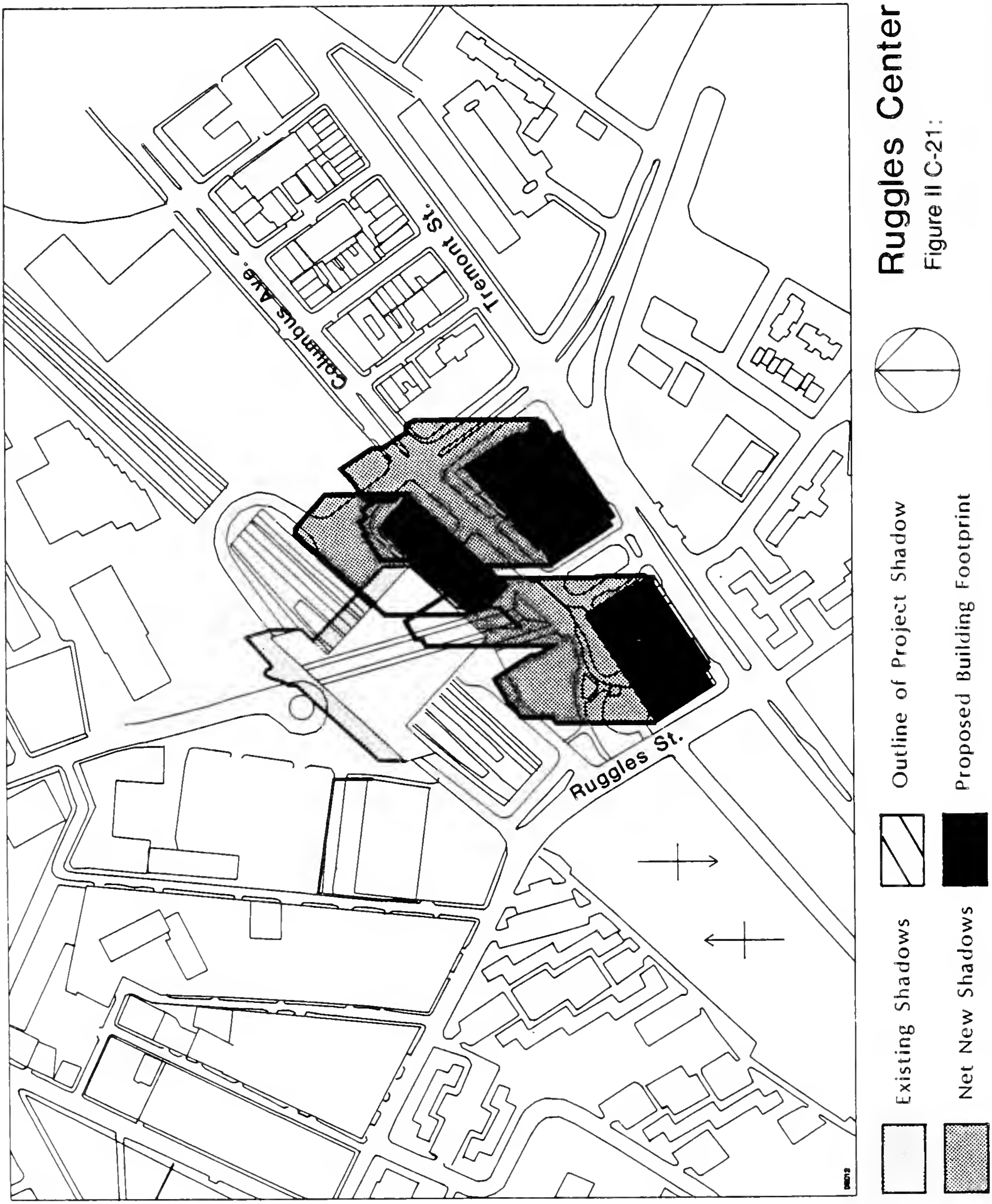
Outline of Project Shadow

Proposed Building Footprint

Ruggles Center

Figure II C-20
Shadow Diagram

(Dec. 21, 9 AM)

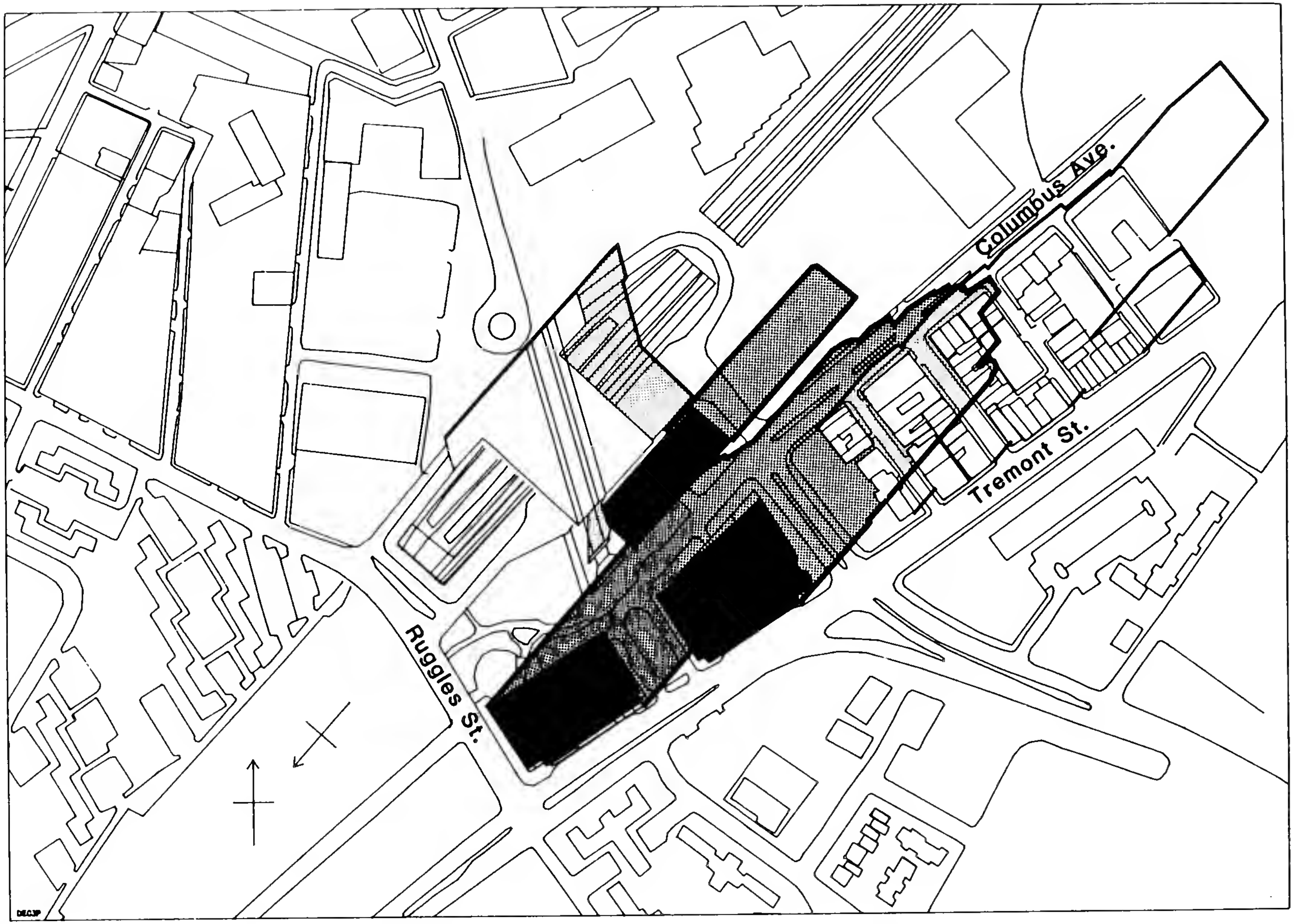


Ruggles Center

Figure II C-21:

Shadow Studies/Master Plan Design

(Dec. 21, Noon)



Existing Shadows

Net New Shadows

Outline of Project Shadow

Proposed Building Footprint

Ruggles Center

Figure II C-22:

Shadow Studies/Master Plan Design

(Dec. 21, 3 PM)

D. Wind

Introduction

For the FEIR, a special quantitative wind speed analysis was conducted to accurately define the existing wind conditions at the Ruggles Center site and to quantify the impact of the Master Plan Design. The objectives of the analysis were to:

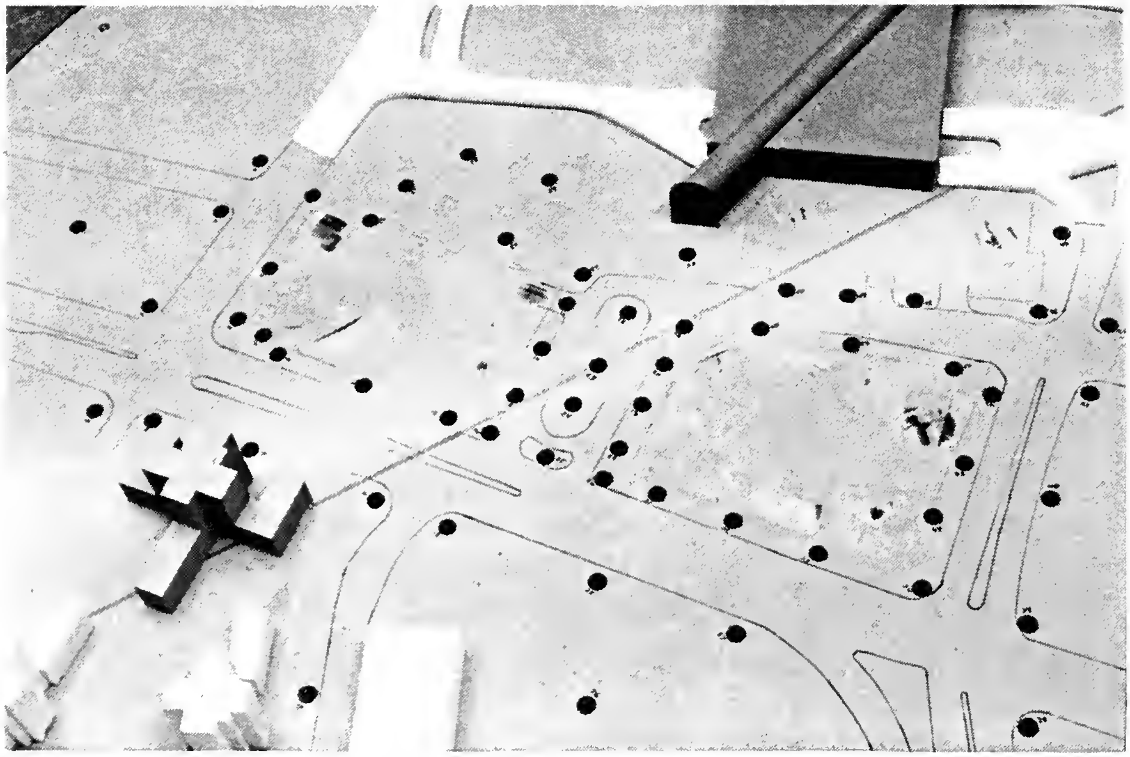
- quantitatively assess the impact that the Ruggles Center would have on the existing pedestrian level wind conditions;
- compare the predicted wind conditions with standards outlined by the Boston Redevelopment Authority (BRA); and
- develop mitigative measures for identified problem areas, if necessary.

To accomplish these objectives, a 1:400 scale model of the existing site and proposed developments and surroundings was tested in a boundary layer wind tunnel. The scale model was constructed in accordance with plans dated June 1, 1989, supplied by the project architects. Information concerning the surrounding site was based on topographical maps and aerial photographs supplied by the Boston Redevelopment Authority (BRA) and building information obtained from the Sanborn Map Company. Additional information concerning site characteristics was obtained during visits to the site.

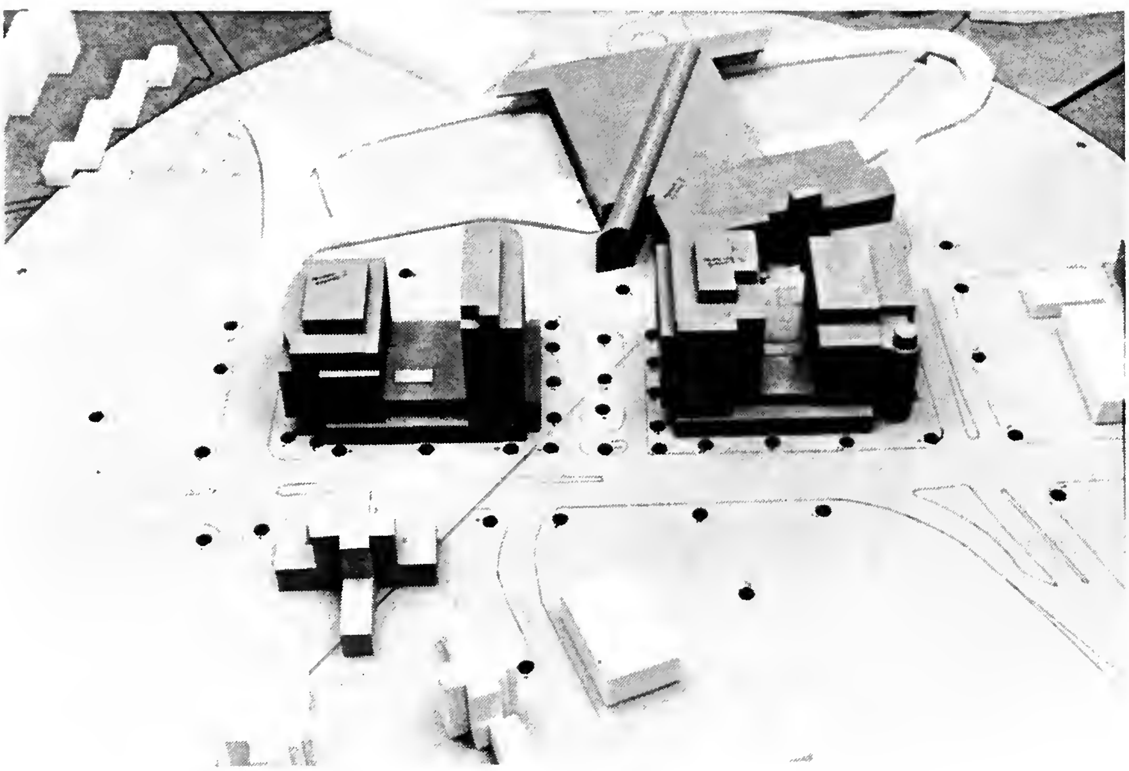
Wind conditions predicted to occur around the proposed development were demonstrated to the design team. In areas predicted to have wind problems, remedial measures were investigated and discussed. A final series of wind tunnel tests was conducted to confirm the effectiveness of the proposed mitigative measures. These involved an initial test to assess the remedial solutions and a second test to refine, optimize and quantify these solutions. The results of these tests, along with the original test results, are summarized in this section and Appendix C.

General Discussion

Major buildings, especially those that protrude well above their surroundings, often cause increased local wind speeds at the pedestrian level. Typically they intercept the winds that exist well above ground level and deflect these winds down to pedestrian level. The



EXISTING SITE CONDITIONS



PROPOSED RUGGLES CENTER

FIGURE II D-1

WIND TUNNEL STUDY MODEL

RUGGLES CENTER, BOSTON, MASSACHUSETTS

funnelling of wind through gaps between buildings and the acceleration of wind around corners may also cause increases in wind speed. Conversely, if a building is surrounded by others of equivalent height, it may be protected from the prevailing winds resulting in no significant changes to the local pedestrian level wind environment. The most effective way to assess potential wind problems around a proposed new building is to conduct scale model tests in a wind tunnel.

The consideration of wind in planning outdoor activity areas is important because high winds in an area tend to deter pedestrian use. For example, in sensitive areas such as outdoor cafes or day care playgrounds where people would be sitting, the winds should be calm. For bus stops and other locations where people would be standing, somewhat higher winds can be tolerated. For frequently used sidewalks, where people are primarily walking, stronger winds are acceptable, and for infrequently used areas, the wind comfort criteria can be relaxed even further. The actual effects of wind can change from inconvenience, due to the pick up of dust and other loose material in a moderate breeze, to severe difficulty with walking due to the wind forces on the pedestrian. The old and infirm are more susceptible to adverse wind effects than the young and the healthy.

Methodology

The 1:400 scale model of the three test configurations and surroundings, within a 1600 ft. radius, was mounted on a turntable in the boundary layer wind tunnel. This wind tunnel is capable of simulating the natural wind. A detailed description of the wind tunnel and the simulation of the natural wind is given in Appendix A.

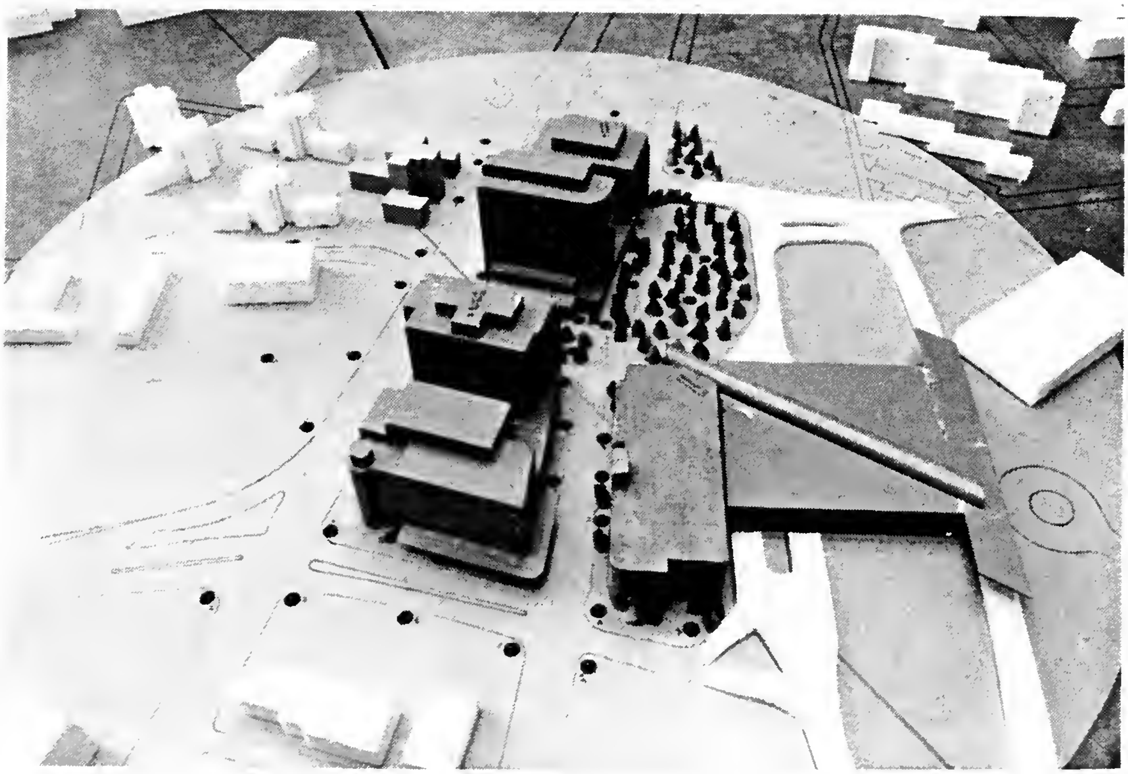
Wind tunnel tests were undertaken for the following test configurations:

A. Existing Site Conditions;

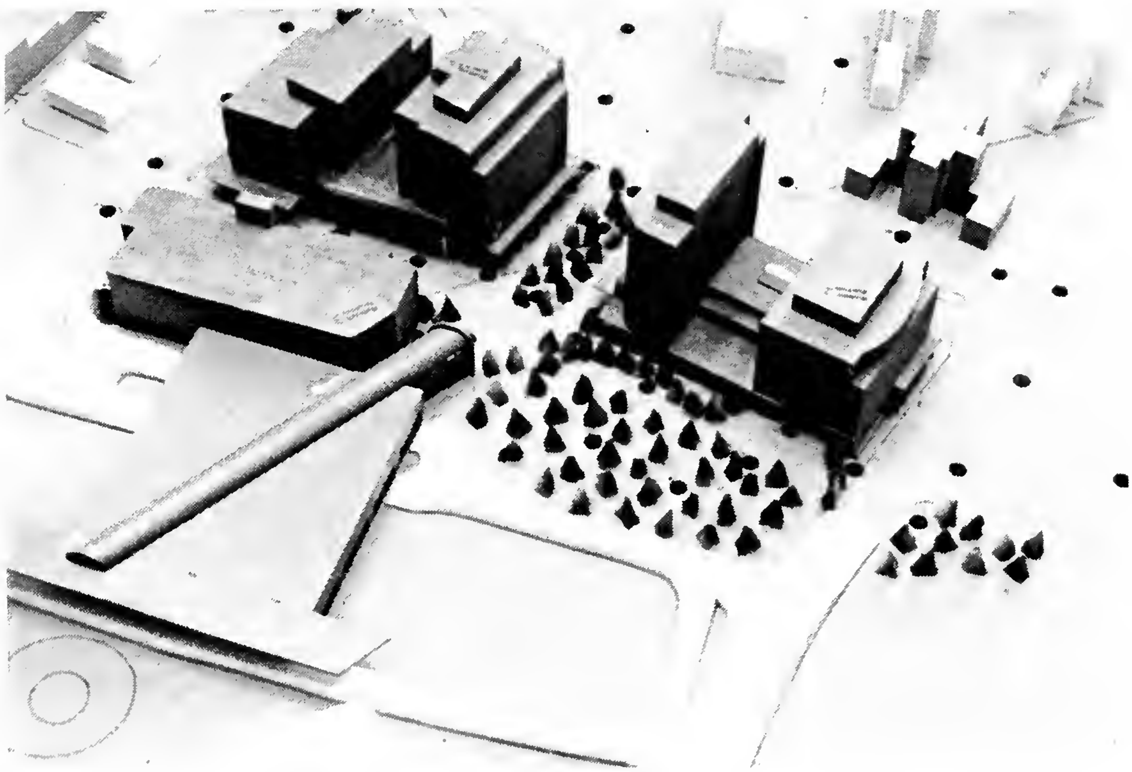
B. Proposed Ruggles Center; and

C. Proposed Ruggles Center with Remedial Solutions.

Photographs of the study model, in the three test configurations, are shown in Figures II D-1 and D-2. The upper photograph in Figure II D-1 shows existing site conditions (Configuration A), the lower



PROPOSED RUGGLES CENTER WITH REMEDIAL SOLUTIONS



PROPOSED RUGGLES CENTER WITH REMEDIAL SOLUTIONS

FIGURE II D-2

WIND TUNNEL STUDY MODEL

RUGGLES CENTER, BOSTON, MASSACHUSETTS

photograph in Figure II D-1 represents the proposed Ruggles Center (Configuration B), and Figure II D-2 shows Ruggles Center with remedial solutions (Configuration C).

A comparison of pedestrian level winds at each sensor location for existing site conditions and the proposed development determines the impact of the development at each location. If the comparison of results identifies locations where the development has an adverse impact, and the levels of pedestrian comfort are not acceptable, then remedial devices are designed to eliminate the problem. The size and placement of these remedial measures are then tested to make certain that unacceptable wind conditions are improved.

The model was fitted with 60 omnidirectional wind speed sensors that were coupled to the wind tunnel's data acquisition system to record the mean and fluctuating components of wind speed at a full scale height of 5 ft. Figure II D-15 shows the location of wind sensors on the site. Wind speeds were recorded and analyzed for 16 wind directions, in 22.5 degree increments, starting from true north.

The test data were then combined with long term meteorological data recorded at Boston's Logan International Airport in order to predict wind speeds which would be exceeded 1% of the time at each test location. For this study, hourly wind records for each of the four seasons and over the entire year were analyzed. The results of the meteorological analysis are graphically presented at the end of this section in Figures II D-3 to D-7 as pedestrian level winds 5 ft. above grade.

A summary of the spring (March, April and May) wind data for Logan International Airport is shown in Figure II D-3. The solid line on this figure indicates the frequency of occurrence of a given wind for each 22.5 degree sector when all winds are considered. This plot indicates that the west through northwest winds occur most often when considering all winds (approximately 29% of the time). However, when only the pedestrian level winds (i.e. 5 ft. above ground level) that exceed 16 mph are included in the analysis (represented by the broken line in Figure II D-3), the most predominant directions are from the northeast (19%), the west (22%) and the west-northwest (24%). It should be noted that the 16 mph threshold speed will occur, on average, one percent of the time during the spring season in the Boston area.

In Figure II D-4, prevailing summer (June, July and August) winds in Boston are from the south-southwest through west-southwest (32%) when considering all winds. When only the winds above the one percent probability wind speed of 12 mph (note: this threshold wind speed changes slightly with the season) are considered, winds from the northeast (14%), southwest (18%), west-southwest (13%) and west-northwest (13%) prevail.

During the fall months (September, October and November), winds favor the southwest (10%) and west-northwest (11%) when considering all winds as shown in Figure II D-5. However, when considering winds above the one percent probability threshold speed of 15 mph, the northeast (24%), east-northeast (10%) and west through northwest (34%) winds prevail.

For the winter (December, January and February) wind conditions, Figure II D-6 indicates that the prevailing directions are from the west through northwest (42%) when considering all winds. However, for winds above the one percent probability wind speed of 19 mph, the predominant winds are from the northeast (13%), west (19%), west-northwest (21%) and northwest (15%).

Figure II D-7 summarizes the annual wind data. The solid line outlining the frequency of a given wind direction, when considering all winds, shows that the southwest (9%) and west through northwest (30%) winds prevail. For winds above the 15 mph threshold wind speed, the prevailing wind directions are from the northeast (15%) and west through northwest (48%).

To aid in the interpretation of the wind tunnel data and to qualitatively investigate remedial measures, the flow visualization capabilities of an open channel water flume were used. Water flowing over the model represents wind flowing over the actual site. In areas where the wind conditions were of interest, dye was introduced into the water flow in order to determine the nature of the wind flow. Once the direction and magnitude of the wind was identified, the optimum placement of solutions, to improve the wind conditions, was determined. The model was re-tested in the boundary layer wind tunnel to quantify these solutions. A second set of tests was performed to refine these remedial solutions. These results are identified as test configuration C. A description of the water flume and its application are described in Appendix B.

This study used state-of-the-art measurement and analysis techniques to predict the level of comfort expected at each location described. There are, however, three sources of variability that should be considered. First, although the methods of measurement and analysis are performed with precision, the sensation of comfort for an individual can be quite variable. The comfort limits used in this report represent an average for the total population. Variations in age, individual health, clothing and other human factors can change a particular response of an individual. Second, unforseen changes such as the construction or removal of buildings over the course of the life of the Ruggles Center, could affect the conditions experienced at the site. Third, the prediction of wind speeds is necessarily a statistical procedure. The wind speeds quoted are for the frequency of occurrence stated. Higher wind speeds will occur but on a less frequent basis.

Pedestrian Wind Comfort

The BRA has established two standards for assessing the relative wind comfort of pedestrians. First, the BRA wind design guidance criterion states that an effective gust velocity (mean hourly wind speed +1.5 times the root-mean-square wind speed) exceeded 1% of the time should be less than or equal to 31 mph. The second set of criteria used by the BRA to determine the acceptability of specific locations is best known as Melbourne's criteria. These internationally accepted criteria are used to determine the relative level of pedestrian wind comfort based on activities such as walking, standing or sitting. The criteria are as follows:

	Mean Wind Speed (mph) for a 1% Probability
Dangerous Conditions	>27
Uncomfortable for Walking	>19 and ≤27
Comfortable for Walking	>15 and ≤19
Comfortable for Standing	>12 and ≤15
Comfortable for Sitting	≤12

The wind climate found in a typical urban setting in Boston is generally comfortable for sidewalks and pedestrian thoroughfares; but, without any mitigating measures, it is likely to be uncomfortable for more passive activities such as sitting. This wind climate will satisfy the BRA criterion of 31 mph.

Test Results

The predicted mean wind speeds and the level of pedestrian wind comfort for the 60 test locations are shown in the odd numbered tables. A comparison of the effective gust speeds to the BRA 31 mph design criterion is presented in the even numbered tables at the end of this section. Tables II D-1 to D-10 present the spring wind conditions, Tables II D-11 to D-20 identify the summer wind conditions, Tables II D-21 to D-30 identify the fall wind conditions, Tables II D-31 to D-40 identify the winter wind conditions and Tables II D-41 to D-50 identify the annual wind information for both BRA standards. In these tables, test Configuration A represents the results from tests undertaken with the existing conditions in place, test Configuration B represents the results with the proposed Ruggles Center in place and test Configuration C indicates the results for the tests conducted with the remedial devices in place.

The wind speeds outlined in Tables II D-1 through D-50 have also been placed on plans of the study area. They are shown as Figures II D-8 to D-13. Figures II D-8, D-9 and D-10 identify the mean wind velocities at each sensor location, for test Configurations A, B and C, respectively. Figures II D-11, D-12 and D-13 identify the effective gust velocity at each sensor location for test Configurations A, B and C, respectively.

For additional information concerning the effects of each wind direction at any test location, refer to Appendix C. Appendix C contains the wind tunnel test data indicating a relative wind speed at each location for the three test configurations. The data is shown in the form of wind speed ratios and weighting factors which are described at the beginning of the appendix. Using this data, wind speeds for each test configuration can be compared and problem wind directions readily determined.

Pedestrian Level Wind Assessment

The following is a summary of the predicted pedestrian level wind comfort on and around the development site for the three configurations:

A. Existing Site Conditions;

B. Proposed Ruggles Center (prior to the placement of remedial solutions); and

C. Proposed Ruggles Center with Remedial Solutions.

The wind data analysis has been conducted in accordance with the criteria established by the BRA as previously identified in this report.

Remedial Devices

Remedial devices have been recommended for several locations on and around the development site. The implementation of these devices assists in creating a comfortable wind environment for the respective pedestrian activities. The type and location of the recommended devices are identified in Figure II D-14 and detailed in the next section: Assessment of Mean Wind Speeds.

The type of devices recommended in this report include canopies, parapets, and vegetation. A general description of the function of these devices follows.

1. Canopy - A canopy is used to deflect winds that are intercepted at higher levels above grade and directed downward to pedestrian level. The canopy should be constructed 8 to 16 feet above grade and extend a minimum of 6 feet horizontally from the building facade.

2. Parapet Wall - Parapet walls ameliorate the impact of wind flow in two ways; the first is by creating a localized turbulence in the vicinity of the parapet wall which disrupts the acceleration of wind stream lines; the second is by deflecting wind flow from areas of concern.

3. Vegetation - Vegetation can be used to mitigate both horizontal and vertical wind action. Deciduous trees act as a localized canopy as their foliage impedes vertical wind flow and allows pedestrian access at grade level. Deciduous trees, however, are not very effective in mitigating horizontal wind flow at pedestrian level; or wind flow in general during the winter season. Coniferous vegetation is very effective in mitigating horizontal wind flow and can be used during all seasons as it retains its foliage throughout the year. The vegetation recommended as remedial devices in this study is coniferous. Deciduous vegetation may be incorporated or added to the recommended coniferous vegetation as it will increase the level of wind comfort attained in various areas

while the foliage remains intact (i.e. during the summer).

Vegetation may be in the form of trees, shrubs, or a combination of plantings, either in planters or beds. Coniferous trees should be a minimum of 10 feet in height to achieve sufficient effect. Trees of less height will have some impact on the wind velocity; however, it may be several years before the full capabilities of the landscaping are realized. The hedging and planter/vegetation combination should be a minimum of 4.5 feet in height.

If preferred, vegetation may be replaced, in part or in full, with wind screens, lattice work or fencing (40% - 60% porosity). This substitution may be feasible in areas such as the area between the columns of the 12 story office tower along the Plaza. These alternatives are acceptable as they adequately reduce wind velocities.

The type and location of remedial devices recommended for the Ruggles Center include:

1. The Columbus Avenue Extension/Melnea Cass Boulevard corner of the nine story office tower - canopy.

2. The lower roof section between the nine story and twelve story office tower - parapet wall.

3. The MBTA driveway side of the parking garage/commercial development - localized vegetation/landscaping.

4. The Plaza side of the twelve story office tower - canopy and vegetation/landscaping.

5. The Plaza Island - vegetation/landscaping.

6. The Southwest Corridor Park - vegetation/landscaping.
7. The Ruggles Street side of the nine story office tower - canopy and vegetation/landscaping.

8. MBTA station entrance - vegetation/landscaping.

9. The Play Area - vegetation/landscaping.

10. The Columbus Avenue Extension side of the parking structure/commercial development - localized vegetation/landscaping.

The final selection of devices and their design will be made during final design stages by the project proponent with approval of the BRA.

Assessment of Mean Wind Speeds

Sensor plans for each of the three configurations studied are included at the end of this section as Figures II D-8, D-9 and D-10. These plans identify the sixty (60) locations studied and the mean wind velocities for each of the four seasons, plus annually, at each location. The annual analysis may be considered a weighted average of the four seasons as it takes into account the microclimate over the entire 12 month period. The odd numbered Tables, II D-1 through D-49, give a comparative analysis of the mean wind velocities at each location for the three configurations studied.

Melnea Cass Blvd. (Locations 40 - 47)

Under existing conditions, the wind climate along this section of Melnea Cass Boulevard is generally suitable for walking on an annual basis. This level of comfort is also found during the spring and fall seasons. During the winter, the comfort level tends to border between comfortable for walking and uncomfortable for walking. During the summer season, the level of comfort is improved as it tends to be comfortable for standing.

The construction of the proposed development has a split effect. The level of comfort generally remains similar to existing conditions at locations 40, 45, 46, and 47. Locations 41 and 42 are subject to increased wind activity while locations 43 and 44 are subject to a decrease in wind activity. Locations 41 and 42 are primarily influenced by the prevailing west and west-northwest winds. These winds, which are intercepted by the proposed office tower, downwash to pedestrian level and then accelerate around the northerly corner of the development. The decrease in wind activity at locations 43 and 44 results from the blockage of westerly wind by the proposed development.

The remedial devices effectively reduce the wind velocity at locations 41 and 42 and have a positive influence on the surrounding area. The remedial devices tested for this area include: a parapet wall, eight to ten feet in height, extending along the lower portion of the

office development; a canopy, eight to sixteen feet above grade, installed along the Columbus Avenue Extension/Melnea Cass Boulevard corner of the nine story office tower; and coniferous landscaping located along the parking garage structure on Melnea Cass Boulevard. The parapet and canopy deflect the downwash of winds away from areas of concern. The canopy should extend the length of the pedestrian arcade on Columbus Avenue. The landscaping primarily reduces localized wind acceleration around the parking garage near location 46. Figure II D-14 identifies the recommended remedial devices.

The main entrance to the office tower is identified by location 44. The level of comfort at this location is well suited, during all seasons, to the associated pedestrian activities.

Tremont Street Between The Plaza and Melnea Cass Blvd.

(Locations 30 - 39)

Under existing conditions, this section of Tremont Street is subject to wind conditions generally suitable for walking during the spring and fall seasons as well as on an annual basis. The exception is the south side of the street during the spring (i.e. locations 35, 36 and 37) which tends to be slightly less comfortable. During the winter season the comfort level is categorized as uncomfortable for walking; while during the summer season, it borders between comfortable for standing and comfortable for walking.

The construction of the proposed development generally improves the wind condition along this section of Tremont Street. During the spring season, the level of comfort at locations 35, 36 and 37 is improved to one suitable for walking. During the winter months, locations 31, 32, 33, 37 and 38 are also improved to suitable for walking. On an annual basis, location 36, an open area to the south of Tremont Street, is improved to a comfort level suitable for walking. The only area subject to an increase in wind activity is the corner of Tremont Street and the Plaza, location 30. The increase in wind activity in this area is primarily due to the prevailing west through northwest winds which act in two ways: (1) they are intercepted by the twelve story office tower, downwash to pedestrian level and accelerate around the corner in question; and (2) they flow, uninterrupted, across the Southwest Corridor Park (SWCP) and are partially channelled between the hotel development and the office development (i.e. through the Plaza area). The channelling of wind through the plaza creates a 'Venturi Effect' which results in an increase in wind velocity.

The implementation of remedial devices reduces wind activity

in the Plaza area, the Southwest Corridor Park and, specifically, at location 30. The remedial devices include: a large number of coniferous plantings in the Southwest Corridor Park; coniferous plantings and/or porous landscaping features in the central island of the Plaza; a canopy on the twelve story office tower along the Plaza; and coniferous landscaping (i.e. in planters) adjacent to the columns of the twelve story office tower along the Plaza. The plantings will reduce the horizontal wind flow through the Southwest Corridor Park and the plaza area, while the canopy will deflect the downwash of winds from areas of concern. The landscaping adjacent to columns should extend approximately four feet either side of the columns. This will still allow pedestrian traffic between the columns/landscaping.

The northwest corner of Tremont Street and Melnea Cass Boulevard, location 34, is subject to a slight increase in wind activity. This area is comfortable for walking during the summer season but borders on a level of comfort suitable for walking/uncomfortable for walking during the spring, fall and on an annual basis. During the winter season, location 34 is subject to wind activity creating a condition uncomfortable for walking; however, this is equivalent to existing conditions. The prevailing winds from the northeast quadrant primarily create the localized condition at this corner. If mitigation is required, some form of landscaping/architectural feature located on Melnea Cass Boulevard will create a localized benefit. The development of the adjacent site on Melnea Cass Boulevard, between Columbus Avenue and Tremont Street, will also assist in reducing the wind velocity at location 34.

Tremont Street Between Ruggles St. and The Plaza

(Locations 4, 8 - 18)

Under existing conditions, this section of Tremont Street is subject to winds creating a level of comfort that varies between suitable for walking and uncomfortable for walking during the spring and on an annual basis. The fall season is primarily comfortable for walking with some areas defined as uncomfortable for walking. The summer season is primarily comfortable for walking with some areas categorized as comfortable for standing. The winter season is generally considered uncomfortable for walking. Location 8, the northwest corner of Ruggles Street and Tremont Street, and location 16, the corner of Ruggles Street and Tremont Street, tend to be slightly windier.

The construction of the proposed development generally maintains the existing conditions with some noted improvements. The main entrance to the nine story office building, at the corner of Ruggles

Street and Tremont Street (location 10), is improved from a wind condition considered uncomfortable for walking during the spring and winter seasons, and annually, to a condition suitable for standing or sitting. Locations 11, 12 and 16 are also improved from uncomfortable for walking to comfortable for walking. This occurs during the spring, winter and fall seasons, respectively. Locations 14 and 15 are subject to a slight increase in wind activity during the spring season and on an annual basis. This increase is mitigated with the implementation of remedial devices. Locations 4, 8, 9, 11 and 14 through 17 are subject to a winter wind environment creating a level of comfort considered uncomfortable for walking. This is an existing condition; however, conditions are slightly improved with the proposed development.

The remedial devices implemented along Ruggles Street and in the Plaza area, for other areas of concern, have a positive effect on this section of Tremont Street as noted for locations 14 and 15.

Location 17 has been grouped with this section of Tremont but it reflects the wind environment along Ruggles Street.

The Plaza Area (Locations 19 - 29)

Under existing conditions, the summer season is comfortable for walking, while the winter season is uncomfortable for walking. During the spring and fall seasons, without remedial measures, these locations border on being uncomfortable for walking.

The construction of the proposed development creates an increase in wind activity in this area. As mentioned earlier, the prevailing west through northwest winds are accelerated as they pass through the constricted zone, or venturi, created by the hotel and twelve story office tower. However, the placement of remedial devices in this area and in the Southwest Corridor Park reduces the wind and creates a comfortable wind climate for all seasons and on an annual basis. The only exceptions are locations 19, 20 and 25, which are subject to a level uncomfortable for walking during the winter season. This condition is localized to these areas and may be rectified with localized landscaping and/or architectural features.

The remedial devices recommended to improve this area include: heavily landscaping the Southwest Corridor Park; landscaping the Plaza traffic island between the hotel and office tower; a canopy on the twelve story office tower along the Plaza; and, coniferous plantings,

or some form of wind screen, between the columns of the office tower. The benefits attained with the implementation of these recommended remedial devices are evident by the large reduction in wind velocity in the Plaza area, particularly on the traffic island between the office tower and hotel. This area is identified by test locations 22, 23 and 24. The large reduction in wind velocity at these locations is primarily due to the extensive landscaping on the traffic island. The wind data obtained suggests that acceptable wind velocities will be attained in this area by moderately landscaping the island rather than densely landscaping it as studied. A canopy on the hotel facade along the Plaza may also be considered as it will deflect winds from the northeasterly quadrant that are occasionally intercepted by the hotel tower and downwashed to pedestrian level. This wind action does not have a large impact in this area; therefore, the canopy may be considered an optional device.

Ruggles Street (Locations 1, 2, 3, 5, 6, 7)

Under existing conditions, this section of Ruggles Street generally borders between comfortable and uncomfortable for walking during the spring and fall seasons and on an annual basis. The summer season is subject to a wind climate suitable for walking, while the winter season is subject to one creating an environment uncomfortable for walking.

The construction of the proposed development creates an increase in wind activity along this section of Ruggles Street. This increased activity is the result of winds from the northwest quadrant accelerating horizontally along the Ruggles Street side of the nine story office tower as well as being intercepted at higher levels and downwashing to pedestrian level. The increased wind activity on the opposite side of Ruggles Street (i.e. locations 5, 6, and 7) results from the blockage and redirection of winds by the office tower/hotel development. The implementation of remedial devices mitigates this increase in wind activity and creates acceptable levels of pedestrian comfort in this area for all seasons. The only exception is location 6 which is subject to a level uncomfortable for walking during the winter season. This is an existing condition that remains after the proposed development is in place.

The remedial devices recommended for this area include: coniferous landscaping around the north corner of the nine story office tower near the play area; a canopy on the office tower along Ruggles Street (the canopy should extend the length of the pedestrian arcade);

planters/wind screen along the office tower on Ruggles Street (i.e. between the columns); and, if possible, coniferous landscaping near the corner of the Parcel 22 access road and Ruggles Street, location 5. It should be noted that the development of the land northwest and west of the study site may improve the wind conditions along this section of Ruggles Street.

Southwest Corridor Park, Play Area, MBTA Station Entrance

(Locations 53 - 59)

Under existing conditions this area is subject to a wind environment generally comfortable for walking during the spring and fall seasons and on an annual basis. The summer climate varies between comfortable for standing and walking, and the winter climate is primarily uncomfortable for walking, with the exception of locations 58 and 59, which are comfortable for walking.

The construction of the proposed development has a split effect on the area. Increased wind activity occurs at locations 54 and 59 decreasing the wind level to uncomfortable for walking at location 54 during the fall and on an annual basis, and at location 59, during the winter season. There is a decrease in wind activity at locations 53 and 56 changing the comfort level from uncomfortable for walking to comfortable for walking or better at location 53 during the spring, fall and winter seasons and on an annual basis. The same improvement occurs at location 56 during the winter season. The improved conditions at location 53 should be noted as it represents the area around the entrance to the MBTA.

The implementation of remedial devices creates a positive effect on the wind environment in this area. The remedial device recommended is extensive landscaping of the Southwest Corridor Park and around the MBTA entrance. This landscaping reduces the prevailing winds, from the northwest quadrant, creating a comfortable wind climate seasonally and annually. The only exceptions are locations 54 and 57 which remain uncomfortable for walking during the winter season. This may be rectified with concentrated landscaping in these areas. Location 57 is of particular interest as it represents a portion of the play area, along with location 56. In general, the wind environment in the play area, with remedial devices in place, is suited to the intended pedestrian activities. However, extra care should be taken to ensure sufficient landscaping along the northwest boundary of this area.

Columbus Avenue Extension

Under existing conditions, this area is comfortable for walking during the spring and fall seasons and on an annual basis. The summer

(Locations 48 - 52, 60)

climate varies between comfortable for standing and walking; the winter climate is primarily uncomfortable for walking.

The construction of the proposed development generally maintains a similar wind climate with the exception of increased wind activity at locations 48 and 51. With the implementation of remedial devices, this area is subject to a seasonal and annual wind environment suitable for the intended pedestrian activities. The only exceptions are locations 51, 52 and 60, which are uncomfortable for walking during the winter season, under existing and proposed conditions.

The remedial devices recommended for this area include: a parapet wall and canopy for the nine story office tower as described earlier; landscaping the Southwest Corridor Park; and localized coniferous landscaping along the Columbus Avenue Extension section of the parking garage/retail development. The winter wind conditions at locations 51, 52 and 60 can be mitigated with some form of landscaping (i.e. planter), wind screen or architecturally designed wind break located along the south side of the Columbus Avenue Extension. These devices will break up the westerly winds travelling parallel to Columbus Avenue. It may, however, be difficult to incorporate such devices given the narrow width of sidewalk.

Assessment of Effective Gust Speeds

Sensor plans for each of the three configurations studied are included as Figures II D-11, D-12 and D-13, respectively. These plans identify the sixty (60) locations studied and the effective gust speeds for each of the four seasons, plus annually, at each location. The even numbered Tables II D-2 through D-50 give a comparative analysis of the effective gust velocities at each location for the three configurations studied.

The construction of the proposed development, including the implementation of remedial devices, results in an improved wind environment on and around the study site. Of the sixty locations tested, all meet the 31 mph effective gust criterion for spring, summer, fall and annually. During the winter season, five locations, 15, 16, 34, 35 and 54, exceed the gust criterion. However, locations 15, 16 and 35 exceed the gust criteria under existing conditions as well. Locations 34 and 54 have an effective gust velocity of 30 mph under existing conditions, this increases to 32 mph with the proposed development and mitigative measures in place. The increase is small but sufficient to exceed the 31 mph criterion. As mentioned earlier, some localized

remedial device, such as coniferous plantings at location 54 and an architectural feature serving as a wind screen at location 34, will help improve the wind conditions in these areas.

Under existing conditions, fourteen of the sixty locations tested exceed the effective gust criterion during the winter season as compared to the five that exceed it with the proposed development and remedial devices in place. The locations exceeding the criterion with existing conditions are: 2, 3, 6, 7, 8, 15, 16, 20, 22, 32, 35, 36, 37, and 53.

Conclusions

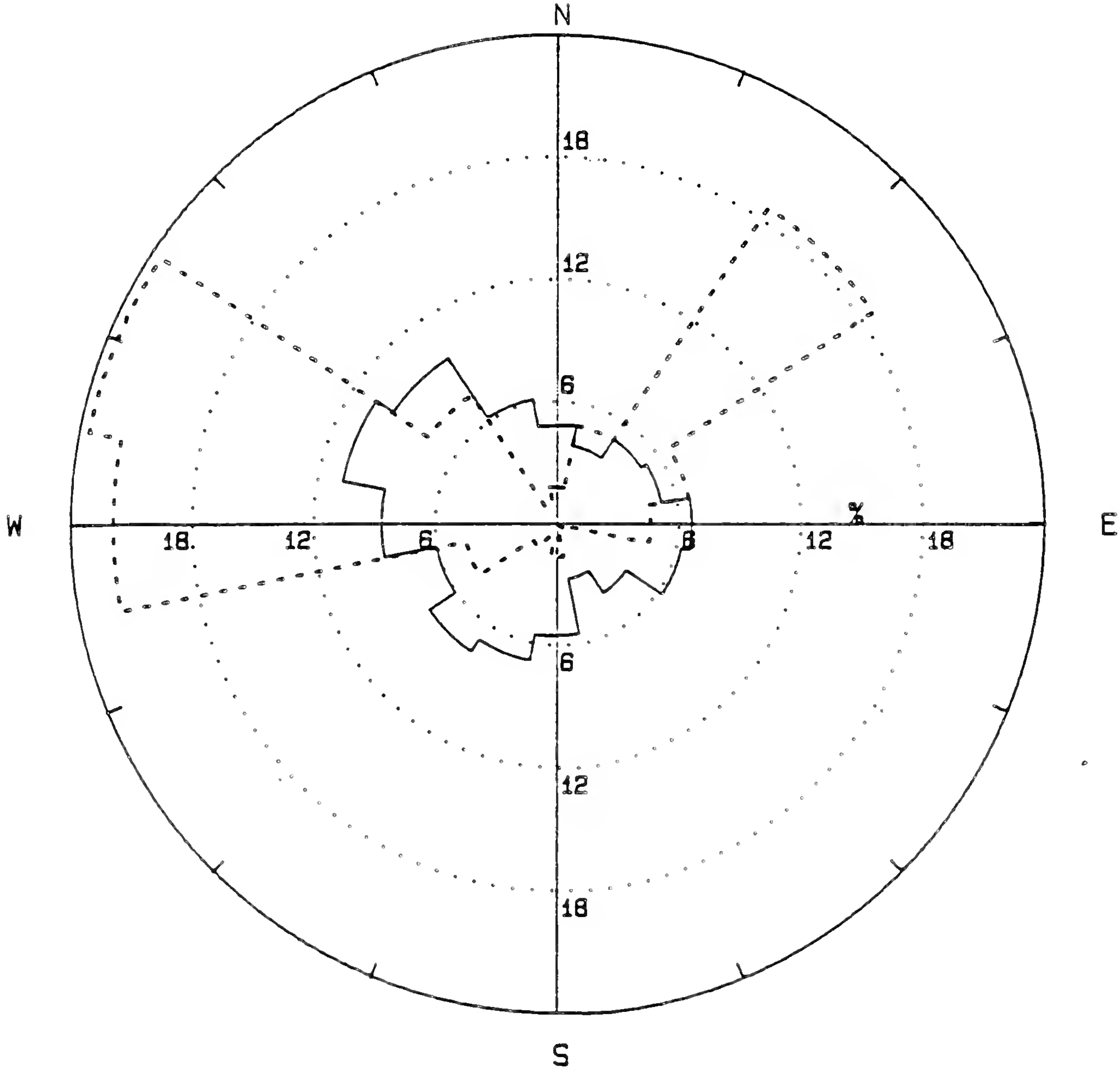
The proposed development, with the recommended remedial devices, has a positive effect on the development site and surrounding area. Under existing conditions, several of the locations tested exceed a mean wind velocity of 19 mph (one percent occurrence) during various seasons throughout the year. This is considered uncomfortable for walking. With the proposed development and remedial devices in place, the number of locations exceeding the mean wind speed of 19 mph is greatly reduced. A similar trend is noted when analyzing the effective gust speed criterion of 31 mph (exceeded one percent of the time). Under existing conditions, fourteen of the sixty locations tested exceed the 31 mph criterion during the winter season. With the proposed development and remedial devices in place, this number is reduced to 5.

The need for remedial measures is noted as there are a number of locations subject to increased wind activity when the proposed development is in place. Prior to the placement of remedial devices, several locations are subject to mean wind speeds greater than 27 mph (exceeded one percent of the time), during the winter season. The same holds true for the effective gust criterion, as several locations are subject to gust speeds greater than 31 mph (exceeded one percent of the time) with the proposed development in place. This is observed at the corner of Melnea Cass Boulevard and the Columbus Avenue Extension as well as in the Plaza area between the hotel and office tower.

The majority of increased wind activity results from the impact of the proposed development on winds from the prevailing northwest quadrant. These winds are: intercepted and downwashed to grade by the office and hotel towers; and, accelerated through the passageways, created by the development, along the Plaza and the Columbus Avenue Extension. The recommended remedial measures greatly improve

the wind conditions creating an acceptable wind climate for the intended pedestrian use.

In summary, the Ruggles Center development will have a positive effect on the existing wind environment, provided that a selection of the recommended remedial devices identified in this report, are selected by the developer, approved by the BRA, and incorporated into the development scheme.



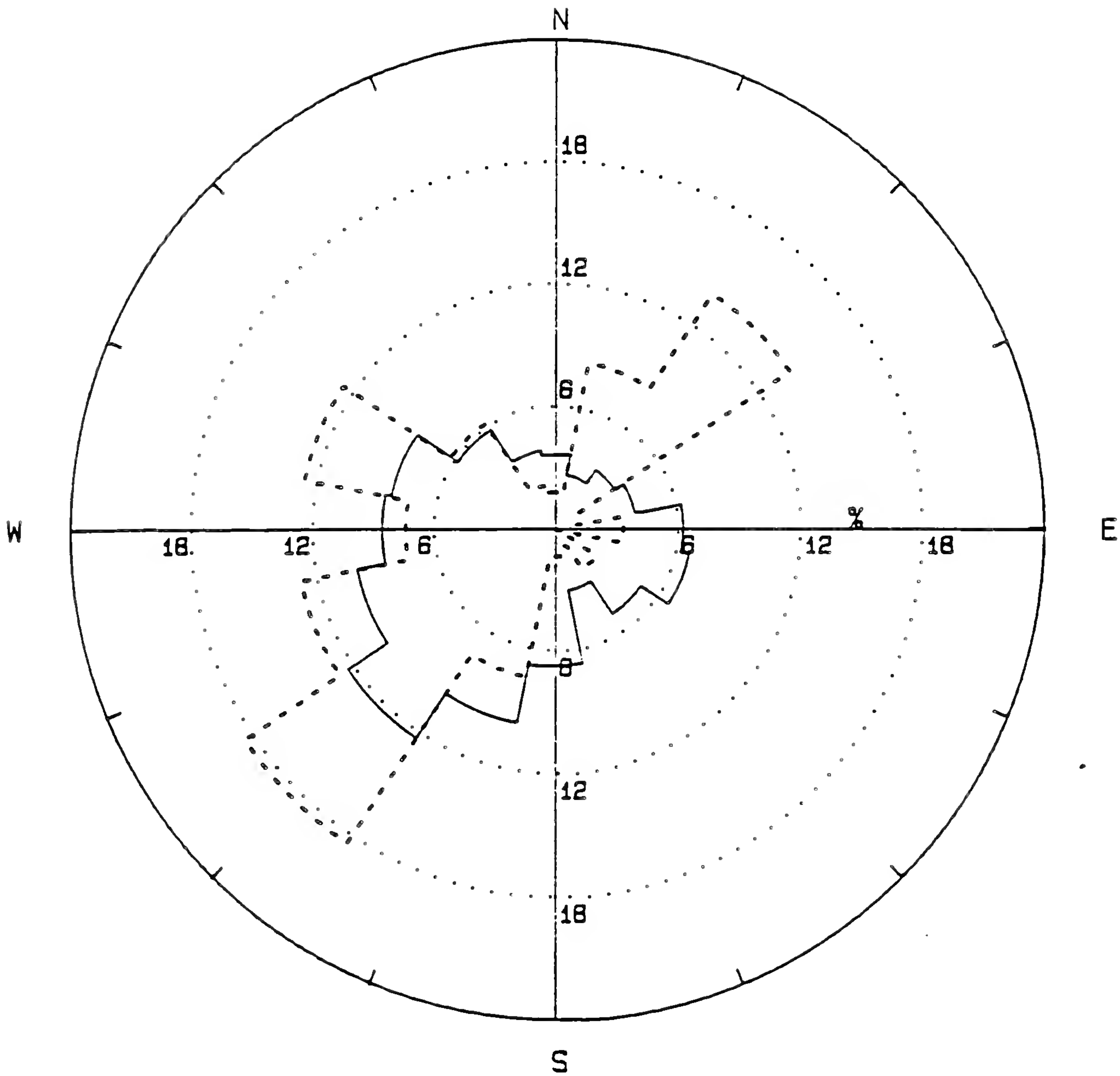
BOSTON, MASSACHUSETTS (1945-1980)

——————— > 0 MPH (ALL WINDS)
- - - - - - - > 16 MPH (EXCEEDED 1% OF THE TIME)

. . . . FREQUENCY OF OCCURRENCE IN %

TICK MARKS INDICATE FROM WHERE THE WIND IS DIRECTED
FREQUENCIES ARE FOR 22.5 DEGREE SECTORS OF THE COMPASS

FIGURE II D-3
DIRECTIONAL DISTRIBUTION OF SPRING WINDS (5ft)



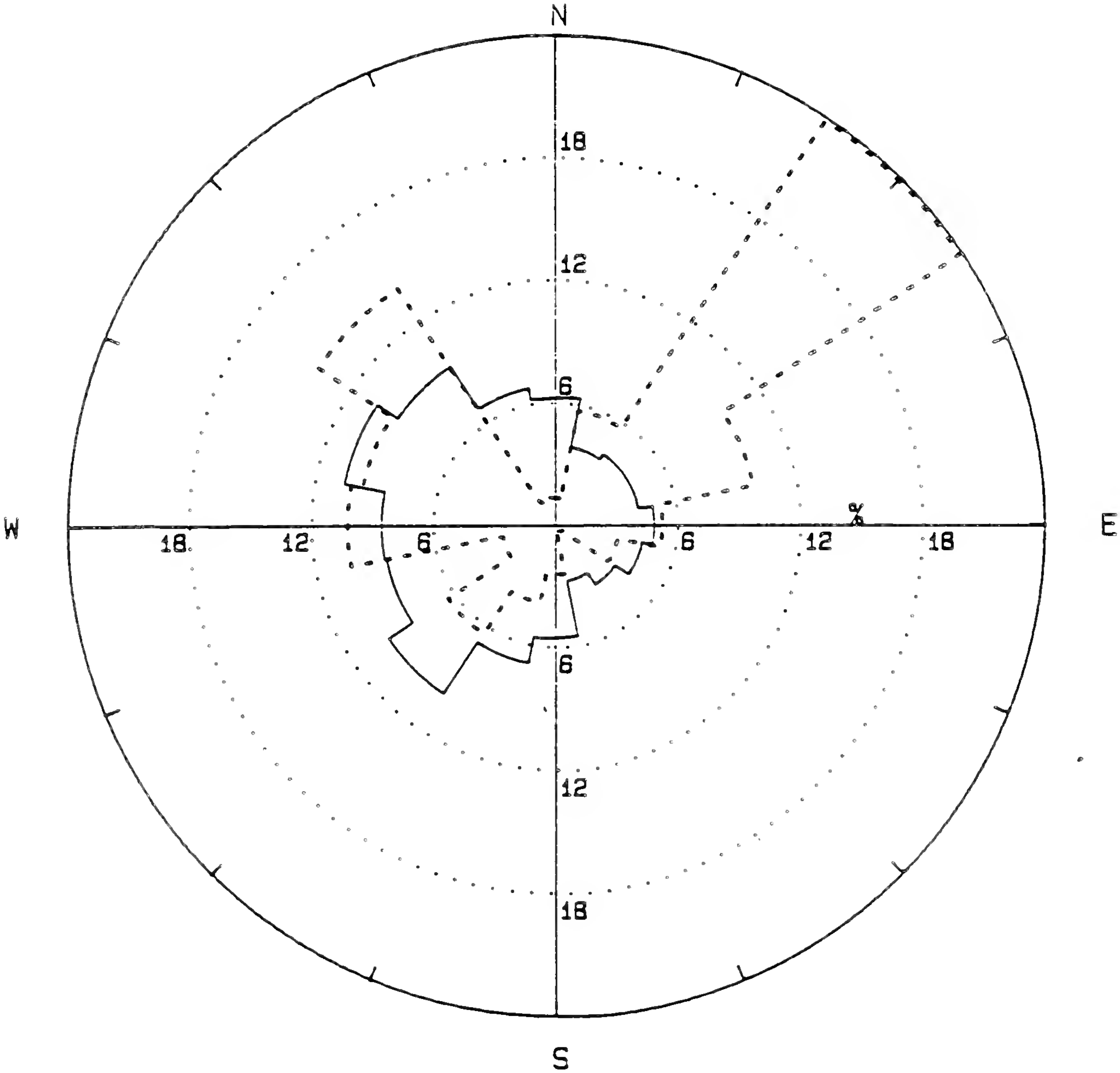
BOSTON, MASSACHUSETTS (1945-1980)

> 0 MPH (ALL WINDS)
> 12 MPH (EXCEEDED 1% OF THE TIME)

FREQUENCY OF OCCURRENCE IN %

TICK MARKS INDICATE FROM WHERE THE WIND IS DIRECTED
FREQUENCIES ARE FOR 22.5 DEGREE SECTORS OF THE COMPASS

FIGURE II D-4
DIRECTIONAL DISTRIBUTION OF SUMMER WINDS (5ft)



BOSTON, MASSACHUSETTS (1945-1980)

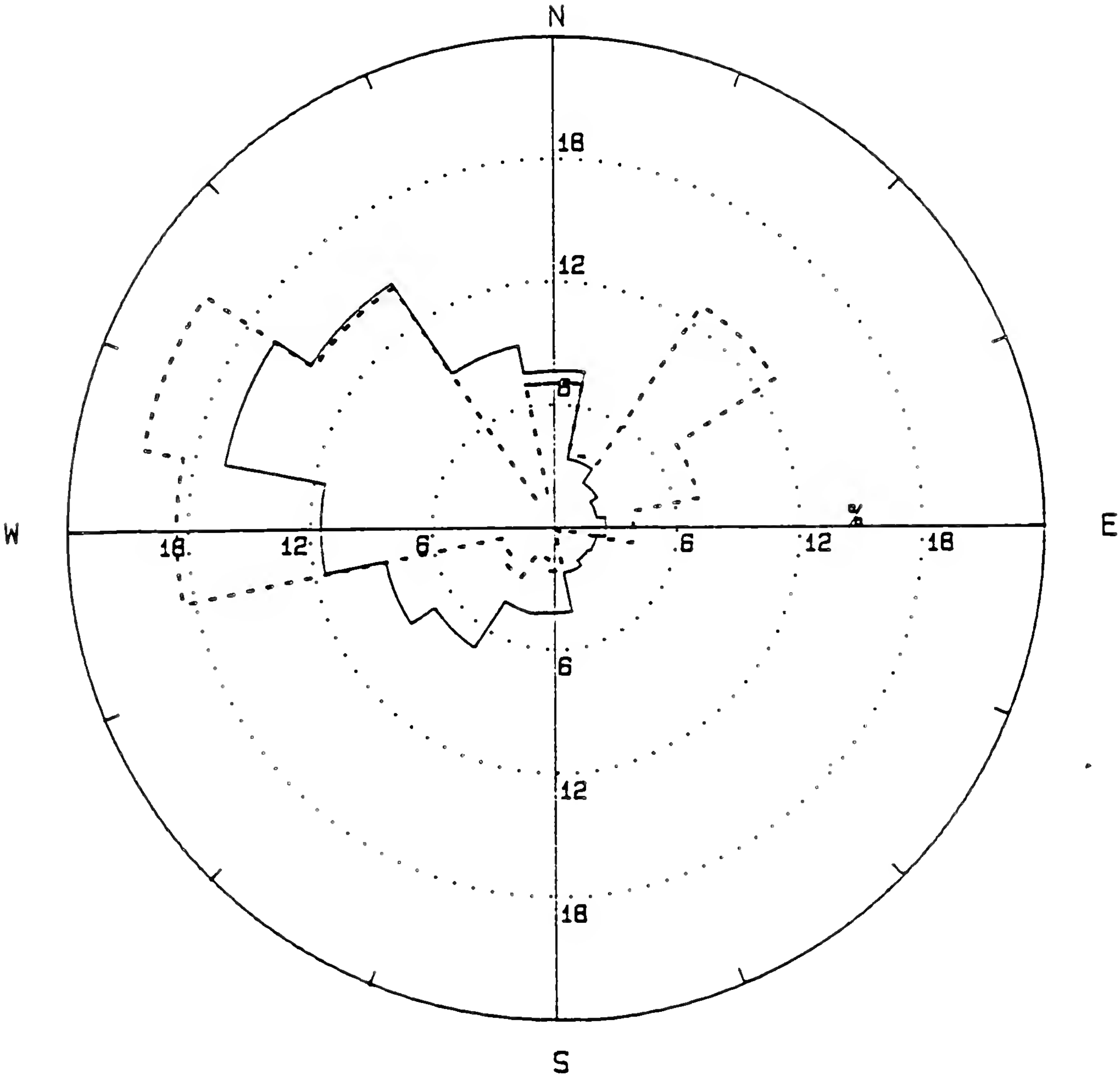
> 0 MPH (ALL WINDS)

> 15 MPH (EXCEEDED 1% OF THE TIME)

FREQUENCY OF OCCURRENCE IN %

TICK MARKS INDICATE FROM WHERE THE WIND IS DIRECTED
FREQUENCIES ARE FOR 22.5 DEGREE SECTORS OF THE COMPASS

FIGURE II D-5
DIRECTIONAL DISTRIBUTION OF FALL WINDS (5ft)



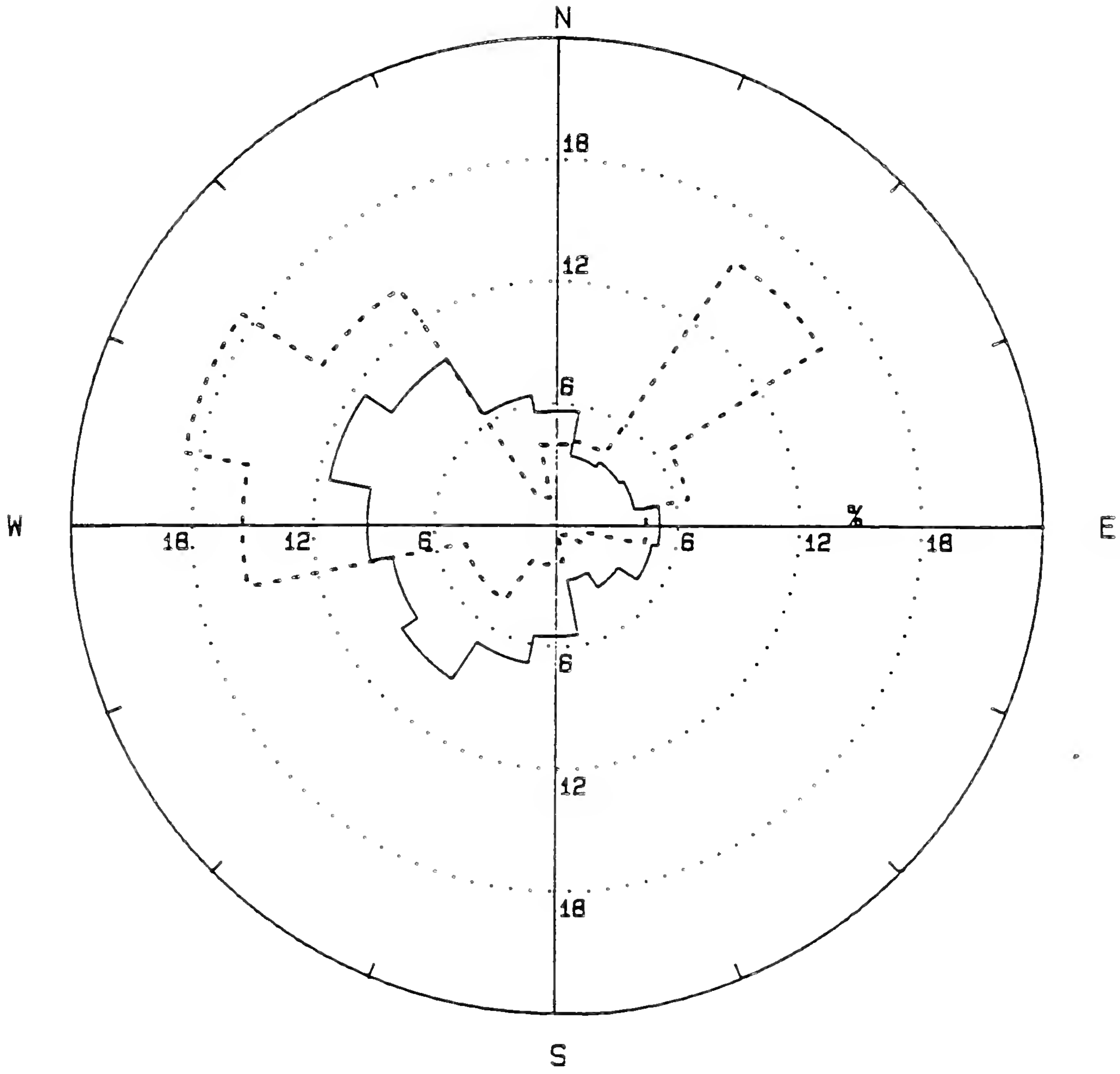
BOSTON, MASSACHUSETTS (1945-1980)

——————— > 0 MPH (ALL WINDS)
- - - - - - - > 19 MPH (EXCEEDED 1% OF THE TIME)

· · · · · · · FREQUENCY OF OCCURRENCE IN %

TICK MARKS INDICATE FROM WHERE THE WIND IS DIRECTED
FREQUENCIES ARE FOR 22.5 DEGREE SECTORS OF THE COMPASS

FIGURE II D–6
DIRECTIONAL DISTRIBUTION OF WINTER WINDS (5ft)



BOSTON, MASSACHUSETTS (1945-1980)

———— > 0 MPH (ALL WINDS)

- - - - - > 15 MPH (EXCEEDED 1% OF THE TIME)

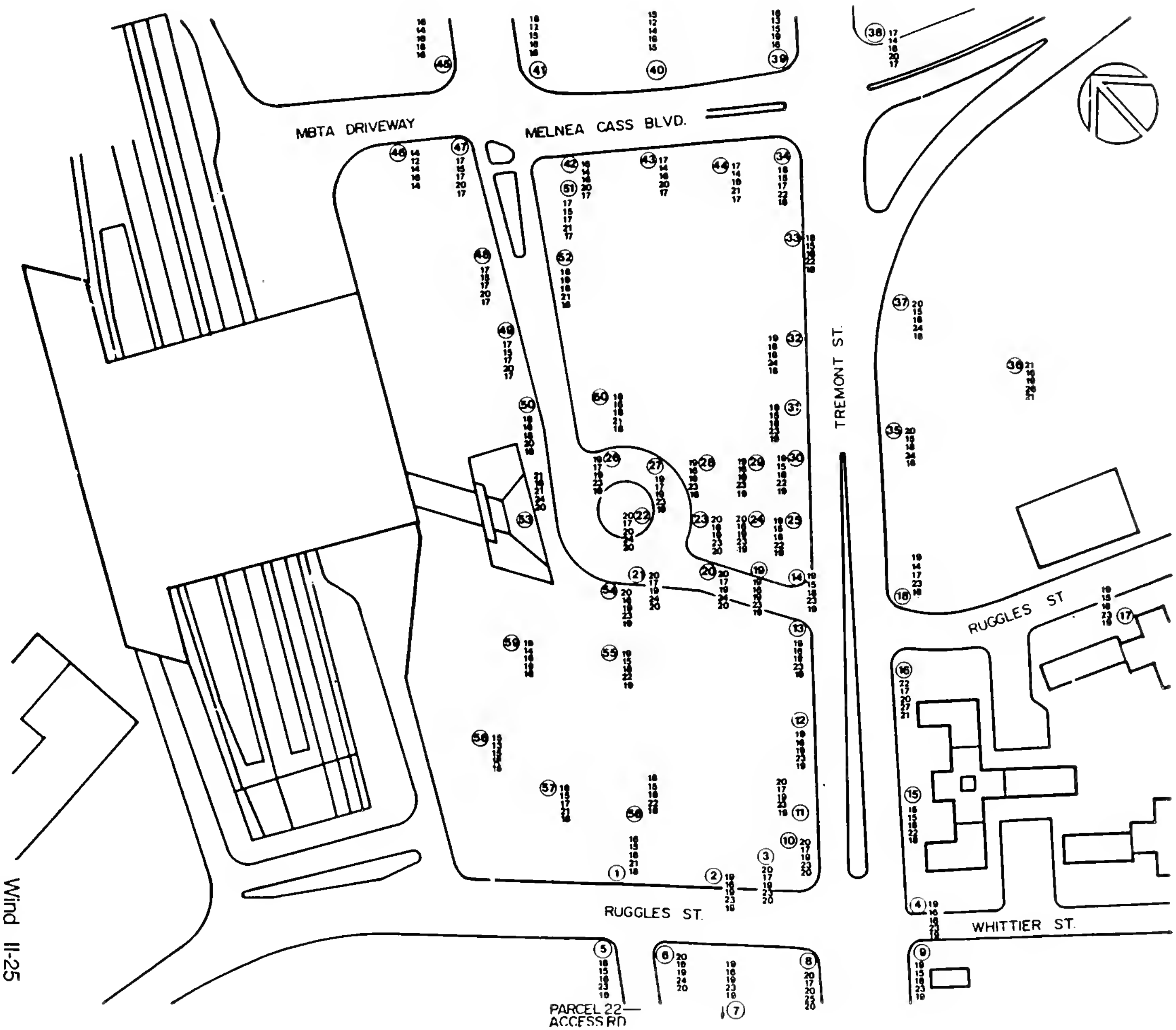
· · · · · · FREQUENCY OF OCCURRENCE IN %

TICK MARKS INDICATE FROM WHERE THE WIND IS DIRECTED

FREQUENCIES ARE FOR 22.5 DEGREE SECTORS OF THE COMPASS

FIGURE II D-7

DIRECTIONAL DISTRIBUTION OF ANNUAL WINDS (5ft)



LEGEND:

○ DENOTES SENSOR LOCATION AND NUMBER

NOTE:

NUMBERS ADJACENT TO SENSOR LOCATIONS INDICATE WIND SPEEDS FOR THAT LOCATION IN THE FOLLOWING ORDER:

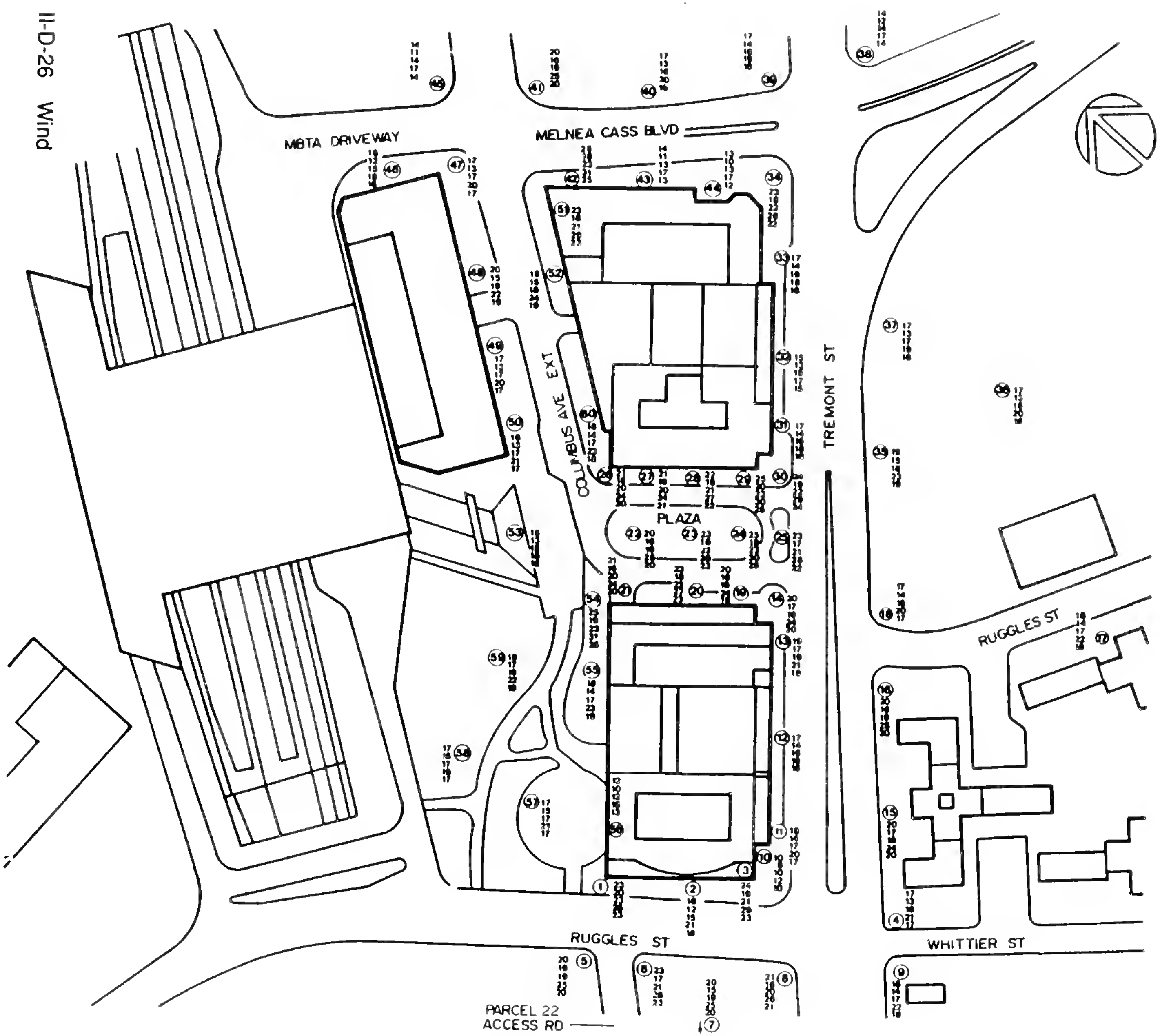
SPRING
SUMMER
FALL
WINTER
ANNUAL

FIGURE II D-8

MEAN WIND SPEEDS FOR THE EXISTING SITE CONDITIONS

APPROX. SCALE 1"=60'

RWDI



LEGEND:

○ DENOTES SENSOR LOCATION AND NUMBER

NOTE:

NUMBERS ADJACENT TO SENSOR LOCATIONS INDICATE WIND SPEEDS FOR THAT LOCATION IN THE FOLLOWING ORDER:

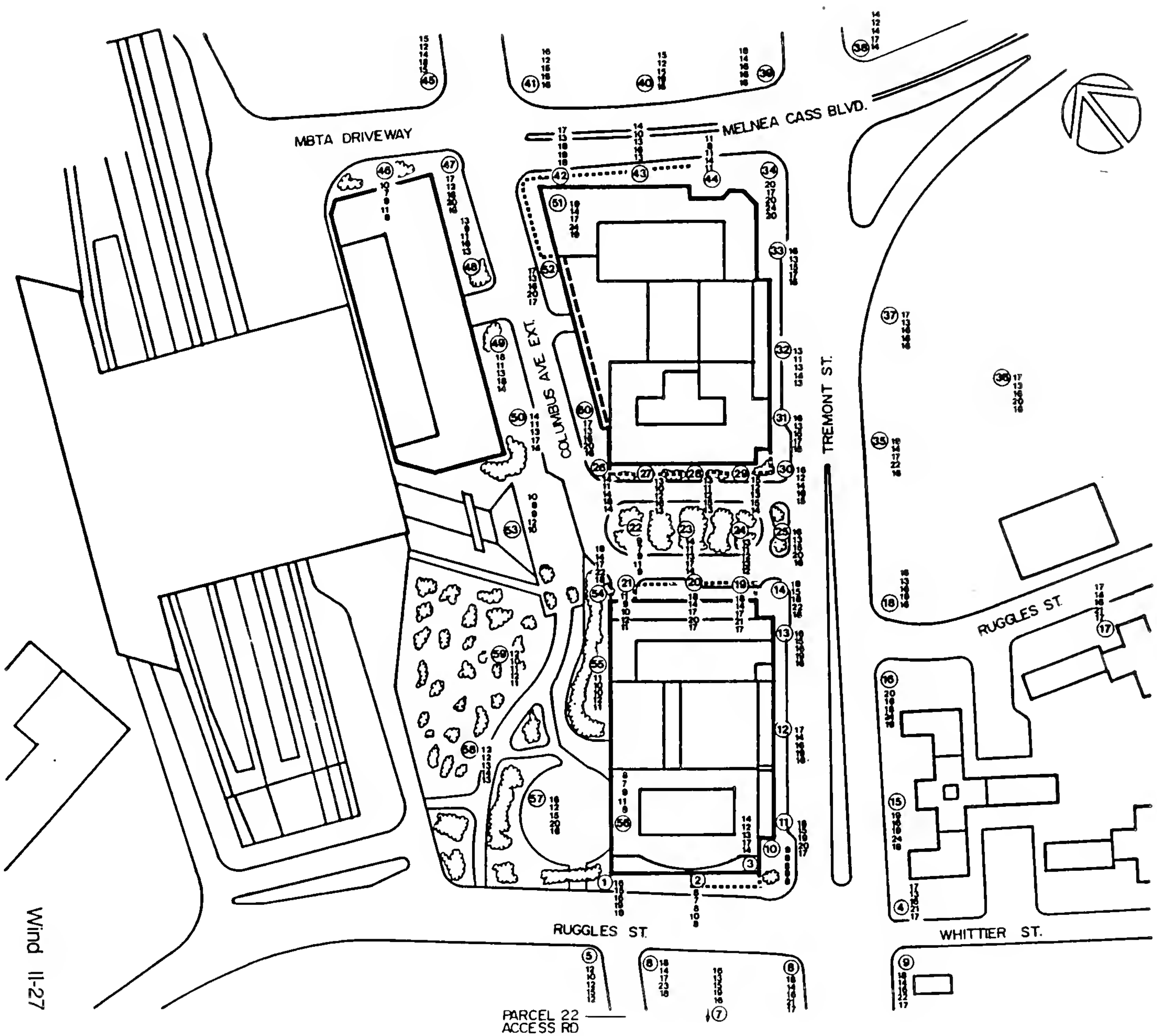
SPRING
SUMMER
FALL
WINTER
ANNUAL

FIGURE II D-9

MEAN WIND SPEEDS FOR THE PROPOSED RUGGLES CENTER

APPROX. SCALE 1"=60'

RWDI



LEGEND:

○ DENOTES SENSOR LOCATION AND NUMBER

NOTE:

NUMBERS ADJACENT TO SENSOR LOCATIONS INDICATE WIND SPEEDS FOR THAT LOCATION IN THE FOLLOWING ORDER:

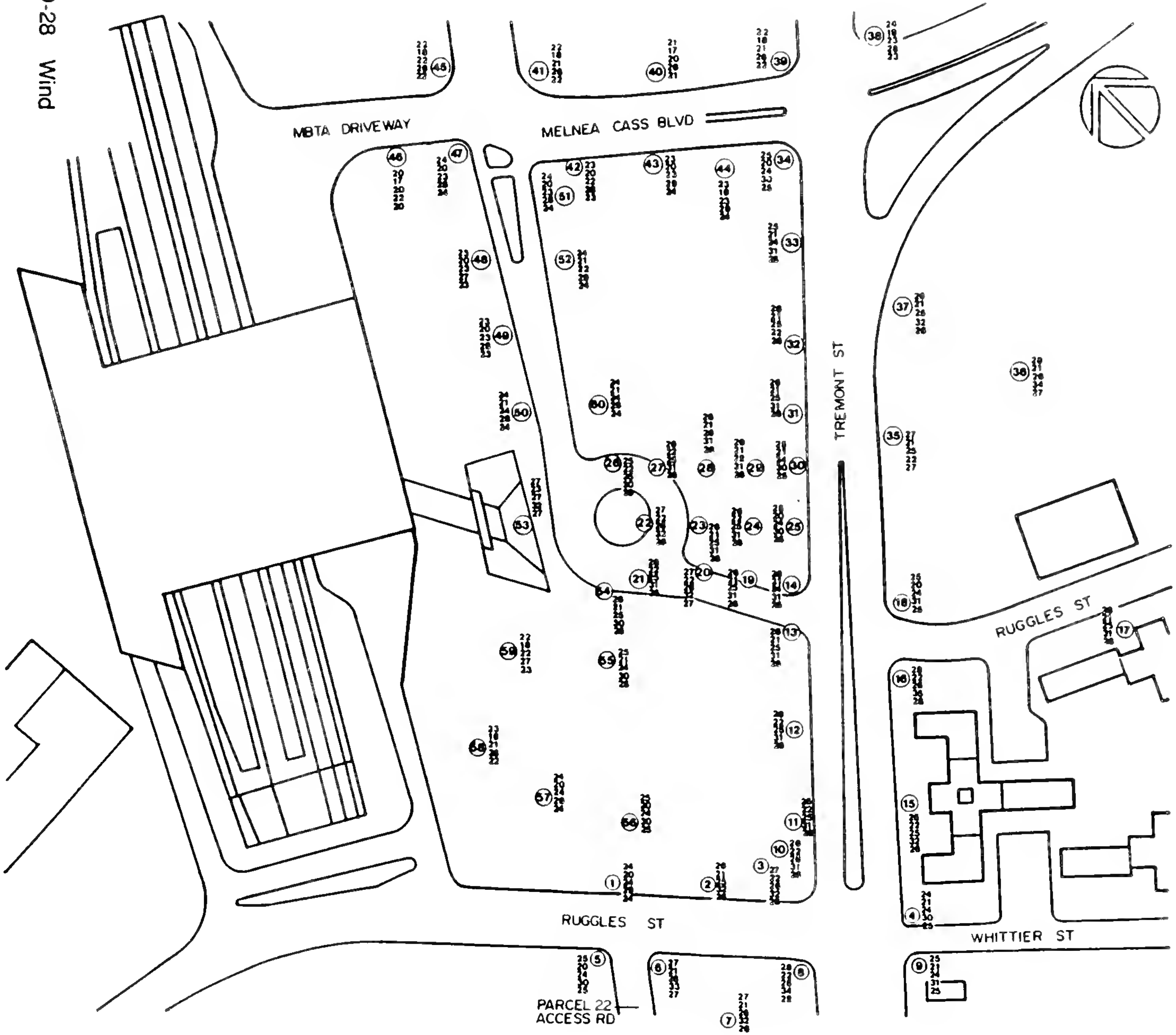
SPRING
SUMMER
FALL
WINTER
ANNUAL

FIGURE II D-10

MEAN WIND SPEEDS FOR THE PROPOSED RUGGLES CENTER WITH REMEDIAL DEVICES

APPROX. SCALE 1"=60'

RWDI



LEGEND:

DENOTES SENSOR LOCATION AND NUMBER

NOTE:

NUMBERS ADJACENT TO SENSOR LOCATIONS INDICATE WIND SPEEDS FOR THAT LOCATION IN THE FOLLOWING ORDER:

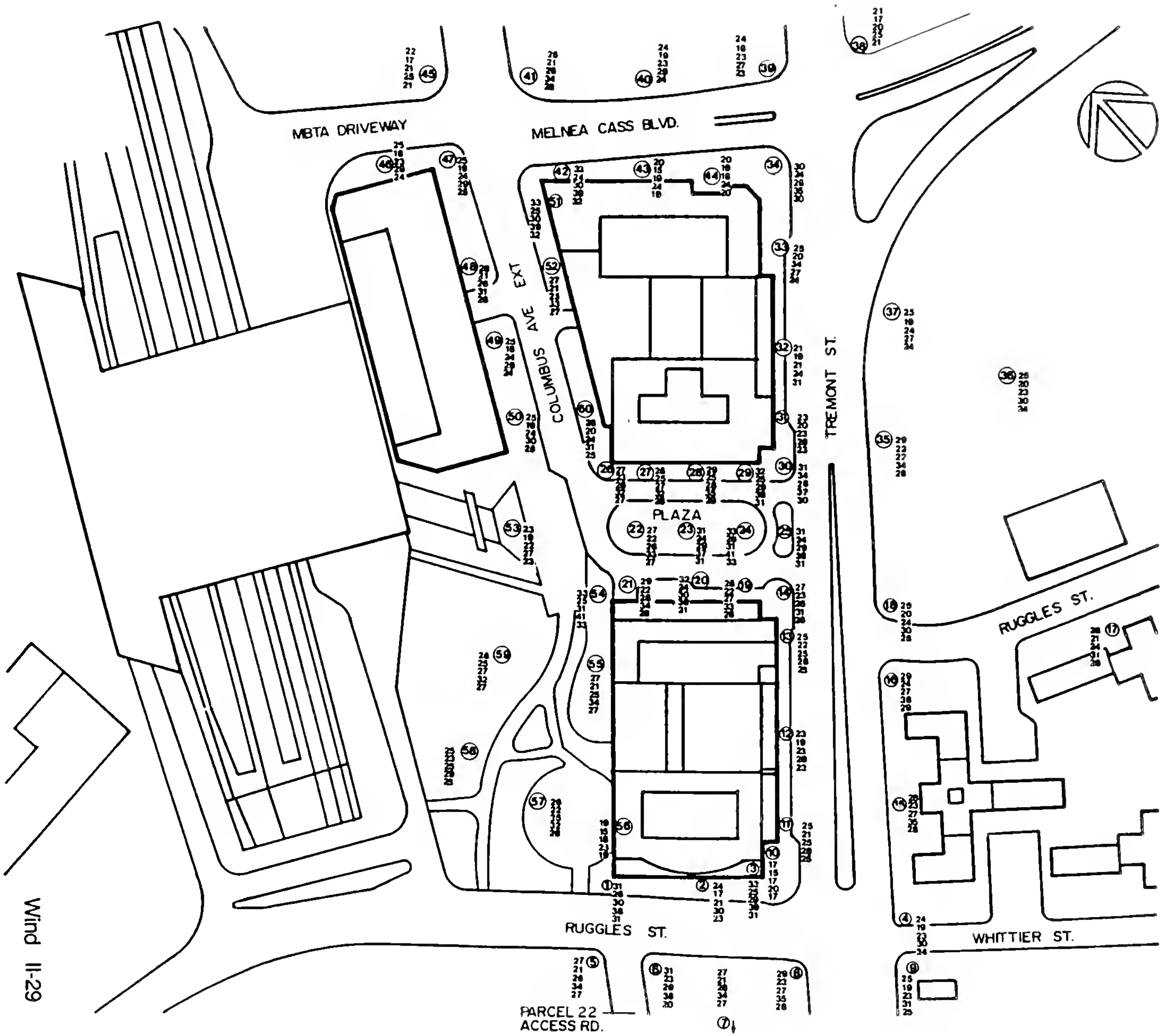
SPRING
SUMMER
FALL
WINTER
ANNUAL

FIGURE II D-11

EFFECTIVE GUST SPEEDS FOR THE EXISTING SITE CONDITIONS

APPROX. SCALE 1"=60'

RWDI



LEGEND:

○ DENOTES SENSOR LOCATION AND NUMBER

NOTE:

NUMBERS ADJACENT TO SENSOR LOCATIONS INDICATE WIND SPEEDS FOR THAT LOCATION IN THE FOLLOWING ORDER:

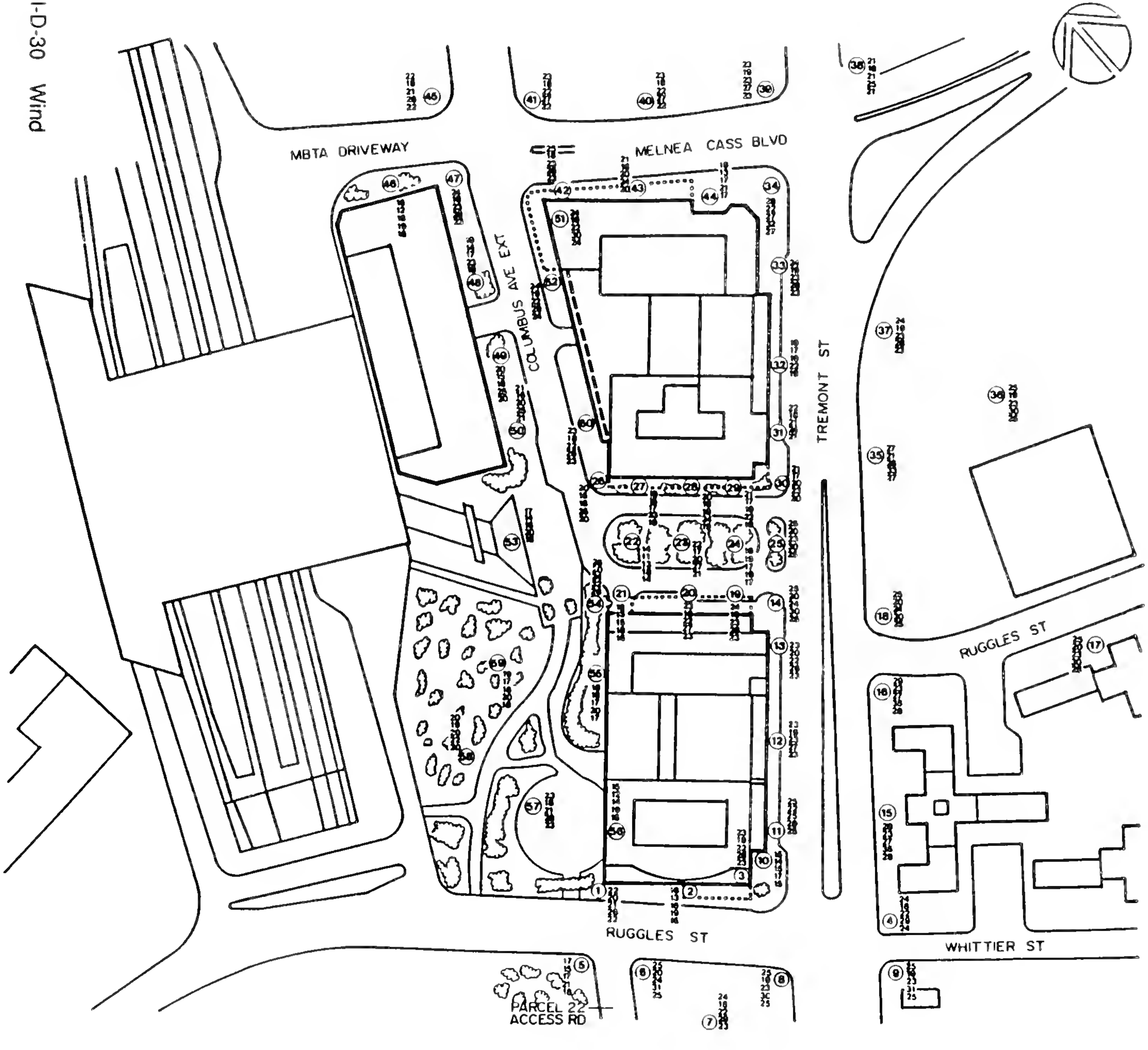
SPRING
SUMMER
FALL
WINTER
ANNUAL

FIGURE II D-12

EFFECTIVE GUST SPEEDS FOR THE PROPOSED RUGGLES CENTER

APPROX. SCALE 1"=60'

RWDI



LEGEND:

○ DENOTES SENSOR LOCATION AND NUMBER

NOTE:

NUMBERS ADJACENT TO SENSOR LOCATIONS INDICATE WIND SPEEDS FOR THAT LOCATION IN THE FOLLOWING ORDER:

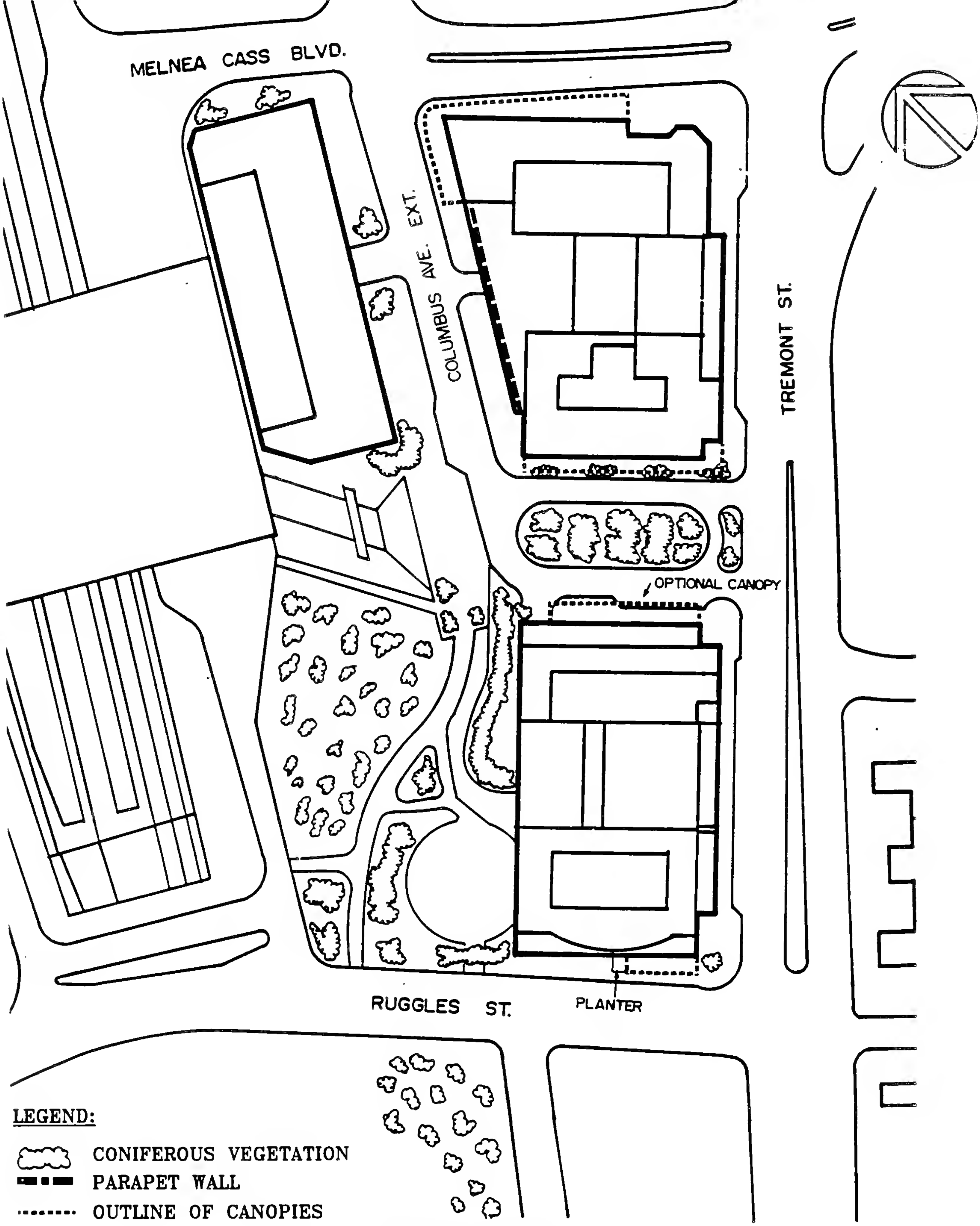
SPRING
SUMMER
FALL
WINTER
ANNUAL

FIGURE II D-13

EFFECTIVE GUST SPEEDS FOR THE PROPOSED RUGGLES CENTER WITH REMEDIAL DEVICES

APPROX. SCALE 1"=60'

RWDI



LEGEND:

CONIFEROUS VEGETATION
PARAPET WALL
OUTLINE OF CANOPIES

FIGURE II D-14

LOCATION OF REMEDIAL DEVICES

APPROX. SCALE 1"=60'

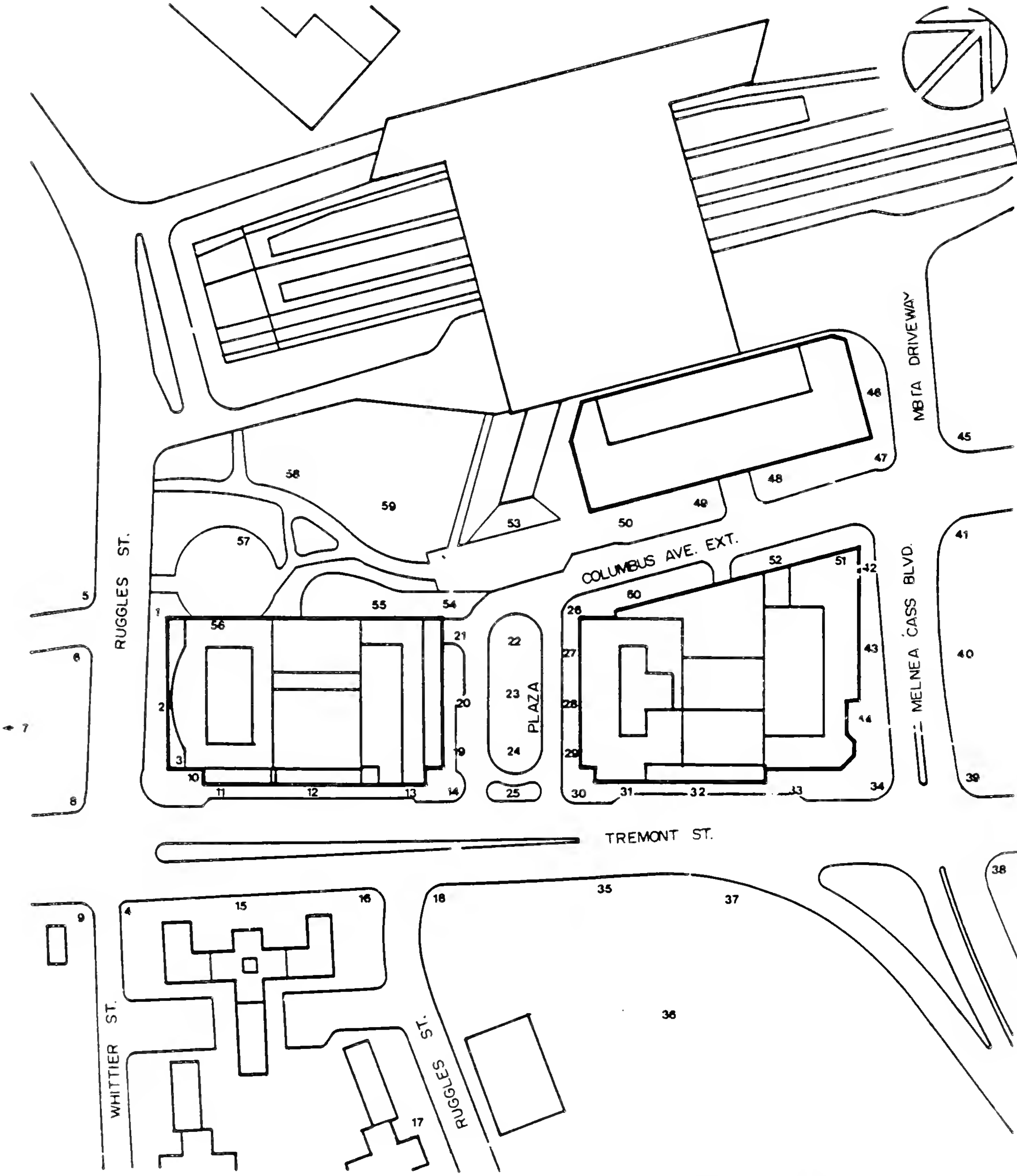


FIGURE II D-15
LOCATION OF WIND SPEED SENSORS
APPROX. SCALE 1"=75'

SUGGESTED MEAN (MPH) WIND SPEEDS FOR -------->

				5 … 10 … 12 … 15 … 19 … 20 … 25+
				SITTING (to 12) · STANDING (12–15) · WALKING (15–19) · UNCOMFORTABLE FOR WALKING (19+) -------->
LOCATION	TEST CONDITION	PERCENTAGE CHANGE	MEAN SPEED (MPH)	
1	A		18	***************************
	B	+27	23	*************************************
	C	-11	16	***********************
2	A		19	*****************************
	B	-15	16	***********************
	C	-57	8	*******
3	A		20	*******************************
	B	+20	24	***************************************
	C	-30	14	*******************
4	A		19	*****************************
	B	-10	17	*************************
	C	-10	17	*************************
5	A		18	***************************
	B	+11	20	*******************************
	C	-33	12	***************
6	A		20	*******************************
	B	+15	23	*************************************
	C	-10	18	***************************
7	A		19	*****************************
	B		20	*******************************
	C	-15	16	***********************
8	A		20	*******************************
	B		21	*********************************
	C	-10	18	***************************
9	A		19	*****************************
	B		18	***************************
	C		18	***************************
10	A		20	*******************************
	B	-50	10	***********
	C	-60	8	*******
11	A		20	*******************************
	B	-10	18	***************************
	C	-10	18	***************************
12	A		19	*****************************
	B	-10	17	*************************
	C	-10	17	*************************

NOTE: 1) Final asterisk denotes category of pedestrian activity for which the predicted winds are suitable.
2) % Change greater than 10% based on comparison with Test Condition A.
3) Wind speeds are for a 1% probability.

TEST CONDITION

A EXISTING SITE CONDITIONS
B PROPOSED RUGGLES CENTER
C PROPOSED RUGGLES CENTER WITH REMEDIAL DEVICES

TABLE II D-1

MEAN WIND SPEED EXCEEDED 1 % OF THE TIME

SPRING

<------- ACCEPTABLE ------->|<------ UNACCEPTABLE ------->

LOCATION	TEST CONDITION	PERCENTAGE CHANGE	GUST SPEED (MPH)	10 : 20 : 30 : 40 : 50+
1	A		24	***************
	B	+29	31	**********************
	C		22	*************
2	A		26	*****************
	B		24	***************
	C	-38	16	*******
3	A		27	******************
	B	+18	32	***********************
	C	-14	23	**************
4	A		24	***************
	B		24	***************
	C		24	***************
5	A		25	****************
	B		27	******************
	C	-32	17	********
6	A		27	******************
	B	+14	31	**********************
	C		25	****************
7	A		27	******************
	B		27	******************
	C	-11	24	***************
8	A		28	*******************
	B		29	********************
	C	-10	25	****************
9	A		25	****************
	B		25	****************
	C		25	****************
10	A		26	*****************
	B	-34	17	********
	C	-42	15	******
11	A		26	*****************
	B		25	****************
	C		25	****************
12	A		26	*****************
	B	-11	23	**************
	C	-11	23	**************

NOTE: 1) Final asterisk denotes category of pedestrian activity for which the predicted winds are suitable.
2) % Change greater than 10% based on comparison with Test Condition A.
3) Wind speeds are for a 1% probability.

TEST CONDITION

A	EXISTING SITE CONDITIONS
B	PROPOSED RUGGLES CENTER
C	PROPOSED RUGGLES CENTER WITH REMEDIAL DEVICES

TABLE II D-2

EFFECTIVE GUST SPEED EXCEEDED 1 % OF THE TIME

SPRING

SUGGESTED MEAN WIND SPEEDS FOR (MPH) --------> SITTING (to 12) | STANDING (12–15) | WALKING (15–19) | UNCOMFORTABLE FOR WALKING (above 19) ------->

LOCATION	TEST CONDITION	PERCENTAGE CHANGE	MEAN SPEED (MPH)	5 · 10 · 15 · 20 · 25+
13	A		19	*****************************
	B		19	*****************************
	C	-15	16	***********************
14	A		19	*****************************
	B		20	*******************************
	C		18	***************************
15	A		18	***************************
	B	+11	20	*******************************
	C		19	*****************************
16	A		22	***********************************
	B		20	*******************************
	C		20	*******************************
17	A		19	*****************************
	B		18	***************************
	C	-10	17	*************************
18	A		19	*****************************
	B	-10	17	*************************
	C	-15	16	***********************
19	A		19	*****************************
	B		20	*******************************
	C		18	***************************
20	A		20	*******************************
	B	+15	23	*************************************
	C	-10	18	***************************
21	A		20	*******************************
	B		21	*********************************
	C	-45	11	*************
22	A		20	*******************************
	B		20	*******************************
	C	-55	9	*********
23	A		20	*******************************
	B	+15	23	*************************************
	C	-30	14	*******************
24	A		20	*******************************
	B	+25	25	***
	C	-35	13	*****************

NOTE: 1) Final asterisk denotes category of pedestrian activity for which the predicted winds are suitable.
2) % Change greater than 10% based on comparison with Test Condition A.
3) Wind speeds are for a 1% probability.

TEST CONDITION

A	EXISTING SITE CONDITIONS
B	PROPOSED RUGGLES CENTER
C	PROPOSED RUGGLES CENTER WITH REMEDIAL DEVICES

TABLE II D-3

MEAN WIND SPEED EXCEEDED 1 % OF THE TIME

SPRING

<------- ACCEPTABLE ------->|<----- UNACCEPTABLE ------->

LOCATION	TEST CONDITION	PERCENTAGE CHANGE	GUST SPEED (MPH)	10 : 20 : 30 : 40 : 50+
13	A		26	*****************
	B		25	****************
	C	-11	23	**************
14	A		26	*****************
	B		27	******************
	C		25	****************
15	A		26	*****************
	B		28	*******************
	C		28	*******************
16	A		28	*******************
	B		29	********************
	C		29	********************
17	A		26	*****************
	B		26	*****************
	C		25	****************
18	A		25	****************
	B		25	****************
	C		25	****************
19	A		26	*****************
	B		28	*******************
	C		24	***************
20	A		27	******************
	B	+18	32	***********************
	C	-14	23	**************
21	A		26	*****************
	B	+11	29	********************
	C	-38	16	*******
22	A		27	******************
	B		27	******************
	C	-48	14	*****
23	A		26	*****************
	B	+19	31	**********************
	C	-15	22	*************
24	A		26	*****************
	B	+26	33	************************
	C	+30	18	*********

NOTE: 1) Final asterisk denotes category of pedestrian activity for which the predicted winds are suitable.
2) % Change greater than 10% based on comparison with Test Condition A.
3) Wind speeds are for a 1% probability.

TEST CONDITION

- A EXISTING SITE CONDITIONS
- B PROPOSED RUGGLES CENTER
- C PROPOSED RUGGLES CENTER WITH REMEDIAL DEVICES

TABLE II D-4

EFFECTIVE GUST SPEED EXCEEDED 1 % OF THE TIME

SPRING

SUGGESTED MEAN WIND SPEEDS FOR (MPH) --------->				SITTING (5–12) / STANDING (12–15) / WALKING (15–19) / UNCOMFORTABLE FOR WALKING (19+) ------->
LOCATION	TEST CONDITION	PERCENTAGE CHANGE	MEAN SPEED (MPH)	5 . . . 10 . . . 15 . . . 20 . . . 25+
25	A		19	******************************
	B	+21	23	**************************************
	C	-15	16	************************
26	A		19	******************************
	B	+10	21	**********************************
	C	-26	14	********************
27	A		19	******************************
	B	+10	21	**********************************
	C	-31	13	******************
28	A		19	******************************
	B	+15	22	************************************
	C	-31	13	******************
29	A		19	******************************
	B	+31	25	**
	C	-21	15	**********************
30	A		19	******************************
	B	+26	24	**
	C	-15	16	************************
31	A		19	******************************
	B	-10	17	**************************
	C	-15	16	************************
32	A		19	******************************
	B	-21	15	**********************
	C	-31	13	******************
33	A		18	****************************
	B		17	**************************
	C	-11	16	************************
34	A		18	****************************
	B	+27	23	**************************************
	C	+11	20	********************************
35	A		20	********************************
	B		19	******************************
	C		19	******************************
36	A		21	**********************************
	B	-19	17	**************************
	C	-19	17	**************************

NOTE: 1) Final asterisk denotes category of pedestrian activity for which the predicted winds are suitable.
2) % Change greater than 10% based on comparison with Test Condition A.
3) Wind speeds are for a 1% probability.

TEST CONDITION

A	EXISTING SITE CONDITIONS
B	PROPOSED RUGGLES CENTER
C	PROPOSED RUGGLES CENTER WITH REMEDIAL DEVICES

TABLE II D-5

MEAN WIND SPEED EXCEEDED 1 % OF THE TIME

SPRING

<------- ACCEPTABLE ------->|<----- UNACCEPTABLE ------->

LOCATION	TEST CONDITION	PERCENTAGE CHANGE	GUST SPEED (MPH)	10 : 20 : 30 : 40 : 50+ :
25	A		25	****************
	B	+24	31	**********************
	C		25	****************
26	A		25	****************
	B		27	******************
	C	-20	20	***********
27	A		26	*****************
	B		28	*******************
	C	-26	19	**********
28	A		26	*****************
	B	+11	29	********************
	C	-23	20	***********
29	A		26	*****************
	B	+23	32	***********************
	C	-19	21	************
30	A		25	****************
	B	+24	31	**********************
	C	-16	21	************
31	A		26	*****************
	B	-11	23	**************
	C	-15	22	*************
32	A		26	*****************
	B	-19	21	************
	C	-26	19	**********
33	A		25	****************
	B		25	****************
	C		24	***************
34	A		25	****************
	B	+20	30	*********************
	C	+12	28	*******************
35	A		27	******************
	B		29	********************
	C		27	******************
36	A		28	*******************
	B	-10	25	****************
	C	-10	25	****************

NOTE: 1) Final asterisk denotes category of pedestrian activity for which the predicted winds are suitable.
2) % Change greater than 10% based on comparison with Test Condition A.
3) Wind speeds are for a 1% probability.

TEST CONDITION

A	EXISTING SITE CONDITIONS
B	PROPOSED RUGGLES CENTER
C	PROPOSED RUGGLES CENTER WITH REMEDIAL DEVICES

TABLE II D-6

EFFECTIVE GUST SPEED EXCEEDED 1 % OF THE TIME

SPRING

SUGGESTED MEAN WIND SPEEDS FOR --------> (MPH): SITTING (5–12) | STANDING (12–15) | WALKING (15–19) | UNCOMFORTABLE FOR WALKING --------> (19–25+)

Scale (MPH): 5 : 10 : 12 : 15 : 19 : 20 : 25+

LOCATION	TEST CONDITION	PERCENTAGE CHANGE	MEAN SPEED (MPH)	5 … 10 … 12 … 15 … 19 … 20 … 25+
37	A		20	*******************************
	B	-15	17	*************************
	C	-15	17	*************************
38	A		17	*************************
	B	-17	14	*******************
	C	-17	14	*******************
39	A		16	***********************
	B		17	*************************
	C		16	***********************
40	A		15	*********************
	B	+13	17	*************************
	C		15	*********************
41	A		16	***********************
	B	+25	20	*******************************
	C		16	***********************
42	A		16	***********************
	B	+56	25	***
	C		17	*************************
43	A		17	*************************
	B	-17	14	*******************
	C	-17	14	*******************
44	A		17	*************************
	B	-23	13	*****************
	C	-35	11	*************
45	A		16	***********************
	B	-12	14	*******************
	C		15	*********************
46	A		14	*******************
	B	+14	16	***********************
	C	-28	10	***********
47	A		17	*************************
	B		17	*************************
	C		17	*************************
48	A		17	*************************
	B	+17	20	*******************************
	C	-23	13	*****************

NOTE: 1) Final asterisk denotes category of pedestrian activity for which the predicted winds are suitable.
2) % Change greater than 10% based on comparison with Test Condition A.
3) Wind speeds are for a 1% probability.

TEST CONDITION

A	EXISTING SITE CONDITIONS
B	PROPOSED RUGGLES CENTER
C	PROPOSED RUGGLES CENTER WITH REMEDIAL DEVICES

TABLE II D-7
MEAN WIND SPEED EXCEEDED 1 % OF THE TIME
SPRING

LOCATION	TEST CONDITION	PERCENTAGE CHANGE	GUST SPEED (MPH)	<------- ACCEPTABLE ------->I<------ UNACCEPTABLE -------> 10 : 20 : 30 : 40 : 50
37	A		26	*****************
	B		25	****************
	C		24	***************
38	A		24	***************
	B	-12	21	************
	C	-12	21	************
39	A		22	*************
	B		24	***************
	C		23	**************
40	A		21	************
	B	+14	24	***************
	C		23	**************
41	A		22	*************
	B	+27	28	*******************
	C		23	**************
42	A		23	**************
	B	+39	32	***********************
	C		25	****************
43	A		23	**************
	B	-13	20	***********
	C		21	************
44	A		23	**************
	B	-13	20	***********
	C	-21	18	*********
45	A		22	*************
	B		22	*************
	C		22	*************
46	A		20	***********
	B	+25	25	****************
	C	-20	16	*******
47	A		24	***************
	B		25	****************
	C		24	***************
48	A		23	**************
	B	+21	28	*******************
	C	-17	19	**********

NOTE: 1) Final asterisk denotes category of pedestrian activity for which the predicted winds are suitable.
2) % Change greater than 10% based on comparison with Test Condition A.
3) Wind speeds are for a 1% probability.

TEST CONDITION

- A EXISTING SITE CONDITIONS
- B PROPOSED RUGGLES CENTER
- C PROPOSED RUGGLES CENTER WITH REMEDIAL DEVICES

TABLE II D-8

EFFECTIVE GUST SPEED EXCEEDED 1 % OF THE TIME

SPRING

SUGGESTED MEAN WIND SPEEDS FOR --------> (MPH): SITTING (5–12) | STANDING (12–15) | WALKING (15–19) | UNCOMFORTABLE FOR WALKING (19+) ------->

LOCATION	TEST CONDITION	PERCENTAGE CHANGE	MEAN SPEED (MPH)	5 : 10 : 12 : 15 : 19 : 20 : 25+
49	A		17	*************************
	B		17	*************************
	C	-11	15	*********************
50	A		18	***************************
	B		18	***************************
	C	-22	14	*******************
51	A		17	*************************
	B	+35	23	*************************************
	C	+11	19	*****************************
52	A		18	***************************
	B		19	*****************************
	C		17	*************************
53	A		21	*********************************
	B	-28	15	*********************
	C	-52	10	***********
54	A		20	*******************************
	B	+25	25	***
	C	-10	18	***************************
55	A		19	*****************************
	B		19	*****************************
	C	-42	11	*************
56	A		18	***************************
	B	-33	12	***************
	C	-50	9	*********
57	A		18	***************************
	B		17	*************************
	C	-11	16	***********************
58	A		15	*********************
	B	+13	17	*************************
	C	-13	13	*****************
59	A		16	***********************
	B	+18	19	*****************************
	C	-25	12	***************
60	A		18	***************************
	B		18	***************************
	C		17	*************************

NOTE: 1) Final asterisk denotes category of pedestrian activity for which the predicted winds are suitable.
2) % Change greater than 10% based on comparison with Test Condition A.
3) Wind speeds are for a 1% probability.

TEST CONDITION

A EXISTING SITE CONDITIONS
B PROPOSED RUGGLES CENTER
C PROPOSED RUGGLES CENTER WITH REMEDIAL DEVICES

TABLE II D-9

MEAN WIND SPEED EXCEEDED 1 % OF THE TIME

SPRING

<------- ACCEPTABLE ------->|<----- UNACCEPTABLE ------->

LOCATION	TEST CONDITION	PERCENTAGE CHANGE	GUST SPEED (MPH)	10 : 20 : 30 : 40 : 50
49	A		23	**************
	B		25	****************
	C	-13	20	***********
50	A		24	***************
	B		25	****************
	C	-12	21	************
51	A		24	***************
	B	+37	33	************************
	C		24	***************
52	A		24	***************
	B	+12	27	******************
	C		24	***************
53	A		27	******************
	B	-14	23	**************
	C	-37	17	********
54	A		26	*****************
	B	+26	33	************************
	C		26	*****************
55	A		25	****************
	B		27	******************
	C	-28	18	*********
56	A		25	****************
	B	-24	19	**********
	C	-40	15	******
57	A		24	***************
	B		26	*****************
	C		23	**************
58	A		22	*************
	B	+13	25	****************
	C		20	***********
59	A		23	**************
	B	+21	28	*******************
	C	-17	19	**********
60	A		24	***************
	B		26	*****************
	C		23	**************

NOTE: 1) Final asterisk denotes category of pedestrian activity for which the predicted winds are suitable.
2) % Change greater than 10% based on comparison with Test Condition A.
3) Wind speeds are for a 1% probability.

TEST CONDITION

- A EXISTING SITE CONDITIONS
- B PROPOSED RUGGLES CENTER
- C PROPOSED RUGGLES CENTER WITH REMEDIAL DEVICES

TABLE II D-10

EFFECTIVE GUST SPEED EXCEEDED 1 % OF THE TIME

SPRING

SUGGESTED MEAN WIND SPEEDS FOR --------> (MPH): SITTING (up to 12) | STANDING (12–15) | WALKING (15–19) | UNCOMFORTABLE FOR WALKING -------> (19 and above)

Scale: 5 : 10 : 15 : 20 : 25+

LOCATION	TEST CONDITION	PERCENTAGE CHANGE	MEAN SPEED (MPH)	
1	A		15	*********************
	B	+33	20	*******************************
	C		15	*********************
2	A		16	***********************
	B	-25	12	***************
	C	-56	7	*****
3	A		17	*************************
	B		18	***************************
	C	-29	12	***************
4	A		16	***********************
	B	-18	13	*****************
	C	-18	13	*****************
5	A		15	*********************
	B		16	***********************
	C	-33	10	***********
6	A		16	***********************
	B		17	*************************
	C	-12	14	*******************
7	A		16	***********************
	B		15	*********************
	C	-18	13	*****************
8	A		17	*************************
	B		16	***********************
	C	-17	14	*******************
9	A		15	*********************
	B		14	*******************
	C		14	*******************
10	A		17	*************************
	B	-47	9	*********
	C	-52	8	*******
11	A		17	*************************
	B	-17	14	*******************
	C	-11	15	*********************
12	A		16	***********************
	B	-12	14	*******************
	C	-12	14	*******************

NOTE: 1) Final asterisk denotes category of pedestrian activity for which the predicted winds are suitable.
2) % Change greater than 10% based on comparison with Test Condition A.
3) Wind speeds are for a 1% probability.

TEST CONDITION

- A EXISTING SITE CONDITIONS
- B PROPOSED RUGGLES CENTER
- C PROPOSED RUGGLES CENTER WITH REMEDIAL DEVICES

TABLE II D-11

MEAN WIND SPEED EXCEEDED 1 % OF THE TIME

SUMMER

<------- ACCEPTABLE --------->|<----- UNACCEPTABLE -------->

LOCATION	TEST CONDITION	PERCENTAGE CHANGE	GUST SPEED (MPH)	10 — 20 — 30 — 40 — 50+
1	A		20	***********
	B	+30	26	*****************
	C		20	***********
2	A		21	************
	B	-19	17	********
	C	-38	13	****
3	A		22	*************
	B	+13	25	****************
	C	-13	19	**********
4	A		21	************
	B		19	**********
	C	-14	18	*********
5	A		20	***********
	B		21	************
	C	-25	15	******
6	A		21	************
	B		23	**************
	C		20	***********
7	A		21	************
	B		21	************
	C	-14	18	*********
8	A		22	*************
	B		22	*************
	C	-13	19	**********
9	A		21	************
	B		19	**********
	C		19	**********
10	A		22	*************
	B	-31	15	******
	C	-36	14	*****
11	A		22	*************
	B		21	************
	C		22	*************
12	A		22	*************
	B	-13	19	**********
	C	-13	19	**********

NOTE: 1) Final asterisk denotes category of pedestrian activity for which the predicted winds are suitable.
2) % Change greater than 10% based on comparison with Test Condition A.
3) Wind speeds are for a 1% probability.

TEST CONDITION

- A EXISTING SITE CONDITIONS
- B PROPOSED RUGGLES CENTER
- C PROPOSED RUGGLES CENTER WITH REMEDIAL DEVICES

TABLE II D-12

EFFECTIVE GUST SPEED EXCEEDED 1 % OF THE TIME

SUMMER

SUGGESTED MEAN WIND SPEEDS FOR --------> (MPH): SITTING (to 12) | STANDING (12–15) | WALKING (15–19) | UNCOMFORTABLE FOR WALKING -------> (19+)

Scale: 5, 10, 15, 20, 25+

LOCATION	TEST CONDITION	PERCENTAGE CHANGE	MEAN SPEED (MPH)	5 ... 10 ... 15 ... 20 ... 25+
13	A		16	***********************
	B		17	*************************
	C		15	*********************
14	A		15	*********************
	B	+13	17	*************************
	C		15	*********************
15	A		15	*********************
	B	+13	17	*************************
	C		16	***********************
16	A		17	*************************
	B		16	***********************
	C		16	***********************
17	A		15	*********************
	B		14	*******************
	C		14	*******************
18	A		14	*******************
	B		14	*******************
	C		13	*****************
19	A		16	***********************
	B		16	***********************
	C	-12	14	*******************
20	A		17	*************************
	B		18	***************************
	C	-17	14	*******************
21	A		17	*************************
	B		16	***********************
	C	-47	9	*********
22	A		17	*************************
	B		16	***********************
	C	-58	7	*****
23	A		16	***********************
	B	+12	18	***************************
	C	-31	11	*************
24	A		16	***********************
	B	+18	19	*****************************
	C	-31	11	*************

NOTE: 1) Final asterisk denotes category of pedestrian activity for which the predicted winds are suitable.
2) % Change greater than 10% based on comparison with Test Condition A.
3) Wind speeds are for a 1% probability.

TEST CONDITION

A EXISTING SITE CONDITIONS
B PROPOSED RUGGLES CENTER
C PROPOSED RUGGLES CENTER WITH REMEDIAL DEVICES

TABLE II D-13

MEAN WIND SPEED EXCEEDED 1 % OF THE TIME

SUMMER

LOCATION	TEST CONDITION	PERCENTAGE CHANGE	GUST SPEED (MPH)	<------- ACCEPTABLE -------->|<----- UNACCEPTABLE --------> 10 : 20 : 30 : 40 : 50+
13	A		21	************
	B		22	*************
	C		20	***********
14	A		21	************
	B		23	**************
	C		20	***********
15	A		22	*************
	B		23	**************
	C		23	**************
16	A		22	*************
	B		24	***************
	C		23	**************
17	A		21	************
	B		21	************
	C		20	***********
18	A		20	***********
	B		20	***********
	C		20	***********
19	A		21	************
	B		22	*************
	C		19	**********
20	A		22	*************
	B		24	***************
	C	-18	18	*********
21	A		22	*************
	B		22	*************
	C	-40	13	****
22	A		22	*************
	B		22	*************
	C	-50	11	**
23	A		21	************
	B	+14	24	***************
	C	-19	17	********
24	A		22	*************
	B	+18	26	*****************
	C	-31	15	******

NOTE: 1) Final asterisk denotes category of pedestrian activity for which the predicted winds are suitable.
2) % Change greater than 10% based on comparison with Test Condition A.
3) Wind speeds are for a 1% probability.

TEST CONDITION

A EXISTING SITE CONDITIONS
B PROPOSED RUGGLES CENTER
C PROPOSED RUGGLES CENTER WITH REMEDIAL DEVICES

TABLE II D-14

EFFECTIVE GUST SPEED EXCEEDED 1 % OF THE TIME

SUMMER

SUGGESTED MEAN WIND SPEEDS FOR --------> (MPH): SITTING (up to 12) | STANDING (12–15) | WALKING (15–19) | UNCOMFORTABLE FOR WALKING -------> (above 19)

Scale: 5, 10, 15, 20, 25+

LOCATION	TEST CONDITION	PERCENTAGE CHANGE	MEAN SPEED (MPH)	
25	A		15	*********************
	B	+13	17	*************************
	C	-13	13	*****************
26	A		17	*************************
	B		18	***************************
	C	-35	11	*************
27	A		17	*************************
	B	+11	19	*****************************
	C	-41	10	***********
28	A		16	***********************
	B	+18	19	*****************************
	C	-31	11	*************
29	A		16	***********************
	B	+25	20	*******************************
	C	-25	12	***************
30	A		15	*********************
	B	+26	19	*****************************
	C	-20	12	***************
31	A		15	*********************
	B		14	*******************
	C	-13	13	*****************
32	A		16	***********************
	B	-18	13	*****************
	C	-31	11	*************
33	A		15	*********************
	B		14	*******************
	C	-13	13	*****************
34	A		15	*********************
	B	+20	18	***************************
	C	+13	17	*************************
35	A		15	*********************
	B		15	*********************
	C		14	*******************
36	A		16	***********************
	B	-18	13	*****************
	C	-18	13	*****************

NOTE: 1) Final asterisk denotes category of pedestrian activity for which the predicted winds are suitable.
2) % Change greater than 10% based on comparison with Test Condition A.
3) Wind speeds are for a 1% probability.

TEST CONDITION

A	EXISTING SITE CONDITIONS
B	PROPOSED RUGGLES CENTER
C	PROPOSED RUGGLES CENTER WITH REMEDIAL DEVICES

TABLE II D-15

MEAN WIND SPEED EXCEEDED 1 % OF THE TIME

SUMMER

<------- ACCEPTABLE ------->|<----- UNACCEPTABLE ------->

LOCATION	TEST CONDITION	PERCENTAGE CHANGE	GUST SPEED (MPH)	10 : 20 : 30 : 40 : 50+ :
25	A		20	***********
	B	+20	24	***************
	C		20	***********
26	A		22	*************
	B		23	**************
	C	-31	15	******
27	A		22	*************
	B	+13	25	****************
	C	-31	15	******
28	A		21	************
	B	+19	25	****************
	C	-23	16	*******
29	A		21	************
	B	+19	25	****************
	C	-19	17	********
30	A		21	************
	B	+14	24	***************
	C	-19	17	********
31	A		21	************
	B		20	***********
	C	-14	18	*********
32	A		21	************
	B		19	**********
	C	-19	17	********
33	A		21	************
	B		20	***********
	C		19	**********
34	A		20	***********
	B	+20	24	***************
	C	+10	22	*************
35	A		21	************
	B		23	**************
	C		21	************
36	A		21	************
	B		20	***********
	C		19	**********

NOTE: 1) Final asterisk denotes category of pedestrian activity for which the predicted winds are suitable.
2) % Change greater than 10% based on comparison with Test Condition A.
3) Wind speeds are for a 1% probability.

TEST CONDITION

A EXISTING SITE CONDITIONS
B PROPOSED RUGGLES CENTER
C PROPOSED RUGGLES CENTER WITH REMEDIAL DEVICES

TABLE II D-16

EFFECTIVE GUST SPEED EXCEEDED 1 % OF THE TIME

SUMMER

SUGGESTED MEAN WIND SPEEDS FOR --------> (MPH): SITTING | 12 | STANDING | 15 | WALKING | 19 | UNCOMFORTABLE FOR WALKING ------->

LOCATION	TEST CONDITION	PERCENTAGE CHANGE	MEAN SPEED (MPH)	5 : 10 : 15 : 20 : 25+
37	A		15	*********************
	B	-13	13	*****************
	C	-13	13	*****************
38	A		14	*******************
	B	-14	12	***************
	C	-14	12	***************
39	A		13	*****************
	B		14	*******************
	C		14	*******************
40	A		12	***************
	B		13	*****************
	C		12	***************
41	A		13	*****************
	B	+23	16	***********************
	C		12	***************
42	A		14	*******************
	B	+28	18	***************************
	C		13	*****************
43	A		14	*******************
	B	-21	11	*************
	C	-28	10	***********
44	A		14	*******************
	B	-28	10	***********
	C	-42	8	*******
45	A		14	*******************
	B	-21	11	*************
	C	-14	12	***************
46	A		12	***************
	B		12	***************
	C	-41	7	*****
47	A		15	*********************
	B	-13	13	*****************
	C	-13	13	*****************
48	A		15	*********************
	B		15	*********************
	C	-40	9	*********

NOTE: 1) Final asterisk denotes category of pedestrian activity for which the predicted winds are suitable.
2) % Change greater than 10% based on comparison with Test Condition A.
3) Wind speeds are for a 1% probability.

TEST CONDITION

A EXISTING SITE CONDITIONS
B PROPOSED RUGGLES CENTER
C PROPOSED RUGGLES CENTER WITH REMEDIAL DEVICES

TABLE II D-17

MEAN WIND SPEED EXCEEDED 1 % OF THE TIME

SUMMER

<------- ACCEPTABLE ------->|<----- UNACCEPTABLE ------->

LOCATION	TEST CONDITION	PERCENTAGE CHANGE	GUST SPEED (MPH)	10 · 20 · 30 · 40 · 50+
37	A		21	************
	B		19	**********
	C		19	**********
38	A		19	**********
	B	-10	17	********
	C		18	*********
39	A		18	*********
	B		19	**********
	C		19	**********
40	A		17	********
	B	+11	19	**********
	C		18	*********
41	A		18	*********
	B	+16	21	************
	C		18	*********
42	A		20	***********
	B	+20	24	***************
	C	-10	18	*********
43	A		20	***********
	B	-25	15	******
	C	-20	16	*******
44	A		19	**********
	B	-15	16	*******
	C	-31	13	****
45	A		19	**********
	B	-10	17	********
	C		18	*********
46	A		17	********
	B		18	*********
	C	-29	12	***
47	A		20	***********
	B		19	**********
	C	-10	18	*********
48	A		20	***********
	B		21	************
	C	-30	14	*****

NOTE: 1) Final asterisk denotes category of pedestrian activity for which the predicted winds are suitable.
2) % Change greater than 10% based on comparison with Test Condition A.
3) Wind speeds are for a 1% probability.

TEST CONDITION

A EXISTING SITE CONDITIONS
B PROPOSED RUGGLES CENTER
C PROPOSED RUGGLES CENTER WITH REMEDIAL DEVICES

TABLE II D-18

EFFECTIVE GUST SPEED EXCEEDED 1 % OF THE TIME

SUMMER

SUGGESTED MEAN WIND SPEEDS FOR --------> (MPH)				5 SITTING 10 12 STANDING 15 WALKING 19 20 UNCOMFORTABLE FOR WALKING --------> 25+
LOCATION	TEST CONDITION	PERCENTAGE CHANGE	MEAN SPEED (MPH)	
49	A		15	*********************
	B	-13	13	*****************
	C	-26	11	*************
50	A		16	***********************
	B	-18	13	*****************
	C	-31	11	*************
51	A		15	*********************
	B	+20	18	***************************
	C		14	*******************
52	A		16	***********************
	B		15	*********************
	C	-18	13	*****************
53	A		18	***************************
	B	-27	13	*****************
	C	-55	8	*******
54	A		16	***********************
	B	+18	19	*****************************
	C	-12	14	*******************
55	A		15	*********************
	B		14	*******************
	C	-33	10	***********
56	A		15	*********************
	B	-33	10	***********
	C	-53	7	*****
57	A		15	*********************
	B		15	*********************
	C	-20	12	***************
58	A		13	*****************
	B	+15	15	*********************
	C		12	***************
59	A		14	*******************
	B	+21	17	*************************
	C	-28	10	***********
60	A		16	***********************
	B	-12	14	*******************
	C	-18	13	*****************

NOTE: 1) Final asterisk denotes category of pedestrian activity for which the predicted winds are suitable.
2) % Change greater than 10% based on comparison with Test Condition A.
3) Wind speeds are for a 1% probability.

TEST CONDITION

A	EXISTING SITE CONDITIONS
B	PROPOSED RUGGLES CENTER
C	PROPOSED RUGGLES CENTER WITH REMEDIAL DEVICES

TABLE II D-19

MEAN WIND SPEED EXCEEDED 1 % OF THE TIME

SUMMER

LOCATION	TEST CONDITION	PERCENTAGE CHANGE	GUST SPEED (MPH)	<------- ACCEPTABLE ------->|<------ UNACCEPTABLE -------> 10 20 30 40 50+
49	A		20	***********
	B	-10	18	*********
	C	-25	15	******
50	A		21	************
	B		19	**********
	C	-23	16	*******
51	A		20	***********
	B	+25	25	****************
	C	-10	18	*********
52	A		21	************
	B		21	************
	C		19	**********
53	A		23	**************
	B	-17	19	**********
	C	-39	14	*****
54	A		21	************
	B	+19	25	****************
	C		20	***********
55	A		21	************
	B		21	************
	C	-23	16	*******
56	A		20	***********
	B	-25	15	******
	C	-40	12	***
57	A		20	***********
	B	+10	22	*************
	C	-10	18	*********
58	A		18	*********
	B	+27	23	**************
	C		19	**********
59	A		19	**********
	B	+31	25	****************
	C	-10	17	********
60	A		21	************
	B		20	***********
	C	-14	18	*********

NOTE: 1) Final asterisk denotes category of pedestrian activity for which the predicted winds are suitable.
2) % Change greater than 10% based on comparison with Test Condition A.
3) Wind speeds are for a 1% probability.

TEST CONDITION

A	EXISTING SITE CONDITIONS
B	PROPOSED RUGGLES CENTER
C	PROPOSED RUGGLES CENTER WITH REMEDIAL DEVICES

TABLE II D-20

EFFECTIVE GUST SPEED EXCEEDED 1 % OF THE TIME

SUMMER

SUGGESTED MEAN WIND SPEEDS FOR --------> (MPH): SITTING (to 12) | STANDING (12–15) | WALKING (15–19) | UNCOMFORTABLE FOR WALKING (19+) ------->

LOCATION	TEST CONDITION	PERCENTAGE CHANGE	MEAN SPEED (MPH)	5 . . . 10 . . . 15 . . . 20 . . . 25+
1	A		18	***************************
	B	+27	23	*************************************
	C	-11	16	***********************
2	A		19	*****************************
	B	-21	15	*********************
	C	-58	8	*******
3	A		19	*****************************
	B	+10	21	*********************************
	C	-31	13	*****************
4	A		18	***************************
	B	-11	16	***********************
	C	-11	16	***********************
5	A		18	***************************
	B		19	*****************************
	C	-33	12	***************
6	A		19	*****************************
	B	+10	21	*********************************
	C	-10	17	*************************
7	A		19	*****************************
	B		19	*****************************
	C	-21	15	*********************
8	A		20	*******************************
	B		20	*******************************
	C	-20	16	***********************
9	A		18	***************************
	B		17	*************************
	C	-11	16	***********************
10	A		19	*****************************
	B	-47	10	***********
	C	-57	8	*******
11	A		19	*****************************
	B	-10	17	*************************
	C		18	***************************
12	A		19	*****************************
	B	-15	16	***********************
	C	-15	16	***********************

NOTE: 1) Final asterisk denotes category of pedestrian activity for which the predicted winds are suitable.
2) % Change greater than 10% based on comparison with Test Condition A.
3) Wind speeds are for a 1% probability.

TEST CONDITION

A	EXISTING SITE CONDITIONS
B	PROPOSED RUGGLES CENTER
C	PROPOSED RUGGLES CENTER WITH REMEDIAL DEVICES

TABLE II D-21

MEAN WIND SPEED EXCEEDED 1 % OF THE TIME

FALL

<------- ACCEPTABLE -------->|<----- UNACCEPTABLE -------->

LOCATION	TEST CONDITION	PERCENTAGE CHANGE	GUST SPEED (MPH)	10 : 20 : 30 :| 40 : 50+ :
1	A		24	***************
	B	+25	30	*********************
	C	-12	21	************
2	A		25	****************
	B	-16	21	************
	C	-40	16	*******
3	A		26	*****************
	B	+11	29	********************
	C	-15	22	*************
4	A		24	***************
	B		23	**************
	C		22	*************
5	A		24	***************
	B		26	*****************
	C	-29	17	********
6	A		26	*****************
	B	+11	29	********************
	C		24	***************
7	A		26	*****************
	B		26	*****************
	C	-15	22	*************
8	A		26	*****************
	B		27	******************
	C	-11	23	**************
9	A		24	***************
	B		23	**************
	C		23	**************
10	A		26	*****************
	B	-34	17	********
	C	-42	15	******
11	A		25	****************
	B		25	****************
	C		25	****************
12	A		25	****************
	B	-12	22	*************
	C		23	**************

NOTE: 1) Final asterisk denotes category of pedestrian activity for which the predicted winds are suitable.
2) % Change greater than 10% based on comparison with Test Condition A.
3) Wind speeds are for a 1% probability.

TEST CONDITION

A EXISTING SITE CONDITIONS
B PROPOSED RUGGLES CENTER
C PROPOSED RUGGLES CENTER WITH REMEDIAL DEVICES

TABLE II D-22

EFFECTIVE GUST SPEED EXCEEDED 1 % OF THE TIME

FALL

SUGGESTED MEAN WIND SPEEDS FOR (MPH) --------> SITTING 12 | STANDING 15 | WALKING 19 | UNCOMFORTABLE FOR WALKING ------->

LOCATION	TEST CONDITION	PERCENTAGE CHANGE	MEAN SPEED (MPH)	5 : 10 : 12 : 15 : 19 : 20 : 25+ :
13	A		19	*****************************
	B		19	*****************************
	C	-15	16	***********************
14	A		18	***************************
	B		19	*****************************
	C		18	***************************
15	A		18	***************************
	B		19	*****************************
	C		19	*****************************
16	A		20	*******************************
	B		19	*****************************
	C	-20	18	***************************
17	A		18	***************************
	B		17	*************************
	C	-11	16	***********************
18	A		17	*************************
	B		16	***********************
	C		16	***********************
19	A		19	*****************************
	B		19	*****************************
	C	-10	17	*************************
20	A		19	*****************************
	B	+15	22	***********************************
	C	-10	17	*************************
21	A		19	*****************************
	B		20	*******************************
	C	-47	10	***********
22	A		20	*******************************
	B		19	*****************************
	C	-55	9	*********
23	A		19	*****************************
	B	+15	22	***********************************
	C	-31	13	*****************
24	A		19	*****************************
	B	+21	23	*************************************
	C	-36	12	***************

NOTE: 1) Final asterisk denotes category of pedestrian activity for which the predicted winds are suitable.
2) % Change greater than 10% based on comparison with Test Condition A.
3) Wind speeds are for a 1% probability.

TEST CONDITION

A EXISTING SITE CONDITIONS
B PROPOSED RUGGLES CENTER
C PROPOSED RUGGLES CENTER WITH REMEDIAL DEVICES

TABLE II D-23

MEAN WIND SPEED EXCEEDED 1 % OF THE TIME

FALL

<------- ACCEPTABLE -------->|<----- UNACCEPTABLE ------->

LOCATION	TEST CONDITION	PERCENTAGE CHANGE	GUST SPEED (MPH)	10 : 20 : 30 : 40 : 50+
13	A		25	****************
	B		25	****************
	C	-12	22	*************
14	A		24	***************
	B		26	*****************
	C		24	***************
15	A		25	****************
	B		27	******************
	C		27	******************
16	A		26	*****************
	B		27	******************
	C		27	******************
17	A		25	****************
	B		24	***************
	C		23	**************
18	A		24	***************
	B		24	***************
	C		24	***************
19	A		25	****************
	B		27	******************
	C		23	**************
20	A		26	*****************
	B	+15	30	*********************
	C	-15	22	*************
21	A		25	****************
	B	+12	28	*******************
	C	-40	15	******
22	A		26	*****************
	B		26	*****************
	C	-50	13	****
23	A		25	****************
	B	+16	29	********************
	C	-20	20	***********
24	A		25	****************
	B	+24	31	**********************
	C	-32	17	********

NOTE: 1) Final asterisk denotes category of pedestrian activity for which the predicted winds are suitable.
2) % Change greater than 10% based on comparison with Test Condition A.
3) Wind speeds are for a 1% probability.

TEST CONDITION

- A EXISTING SITE CONDITIONS
- B PROPOSED RUGGLES CENTER
- C PROPOSED RUGGLES CENTER WITH REMEDIAL DEVICES

TABLE II D-24

EFFECTIVE GUST SPEED EXCEEDED 1 % OF THE TIME

FALL

SUGGESTED MEAN WIND SPEEDS FOR --------> (MPH): 5–12 SITTING | 12–15 STANDING | 15–19 WALKING | 19+ UNCOMFORTABLE FOR WALKING ------->

LOCATION	TEST CONDITION	PERCENTAGE CHANGE	MEAN SPEED (MPH)	5 : 10 : 12 : 15 : 19 : 20 : 25+
25	A		18	***************************
	B	+16	21	*********************************
	C	-16	15	*********************
26	A		19	*****************************
	B		20	*******************************
	C	-26	14	*******************
27	A		19	*****************************
	B		20	*******************************
	C	-36	12	***************
28	A		19	*****************************
	B	+10	21	*********************************
	C	-36	12	***************
29	A		19	*****************************
	B	+21	23	*************************************
	C	-31	13	*****************
30	A		18	***************************
	B	+22	22	***********************************
	C	-22	14	*******************
31	A		18	***************************
	B	-11	16	***********************
	C	-16	15	*********************
32	A		19	*****************************
	B	-21	15	*********************
	C	-31	13	*****************
33	A		18	***************************
	B	-11	16	***********************
	C	-16	15	*********************
34	A		17	*************************
	B	+29	22	***********************************
	C	+17	20	*******************************
35	A		18	***************************
	B		18	***************************
	C		17	*************************
36	A		19	*****************************
	B	-15	16	***********************
	C	-15	16	***********************

NOTE: 1) Final asterisk denotes category of pedestrian activity for which the predicted winds are suitable.
2) % Change greater than 10% based on comparison with Test Condition A.
3) Wind speeds are for a 1% probability.

TEST CONDITION

A EXISTING SITE CONDITIONS
B PROPOSED RUGGLES CENTER
C PROPOSED RUGGLES CENTER WITH REMEDIAL DEVICES

TABLE II D-25

MEAN WIND SPEED EXCEEDED 1 % OF THE TIME

FALL

<------- ACCEPTABLE ------->|<----- UNACCEPTABLE ------->

LOCATION	TEST CONDITION	PERCENTAGE CHANGE	GUST SPEED (MPH)	10 : 20 : 30 : 40 : 50 :
25	A		24	***************
	B	+20	29	********************
	C		23	**************
26	A		25	****************
	B		26	*****************
	C	-24	19	**********
27	A		25	****************
	B		27	******************
	C	-32	17	********
28	A		25	****************
	B	+12	28	*******************
	C	-28	18	*********
29	A		25	****************
	B	+16	29	********************
	C	-24	19	**********
30	A		24	***************
	B	+20	29	********************
	C	-16	20	***********
31	A		25	****************
	B		23	**************
	C	-16	21	************
32	A		25	****************
	B	-16	21	************
	C	-24	19	**********
33	A		24	***************
	B		24	***************
	C		23	**************
34	A		24	***************
	B	+20	29	********************
	C	+12	27	******************
35	A		25	****************
	B		27	******************
	C		26	*****************
36	A		26	*****************
	B	-11	23	**************
	C	-11	23	**************

NOTE: 1) Final asterisk denotes category of pedestrian activity for which the predicted winds are suitable.
2) % Change greater than 10% based on comparison with Test Condition A.
3) Wind speeds are for a 1% probability.

TEST CONDITION

A	EXISTING SITE CONDITIONS
B	PROPOSED RUGGLES CENTER
C	PROPOSED RUGGLES CENTER WITH REMEDIAL DEVICES

TABLE II D-26

EFFECTIVE GUST SPEED EXCEEDED 1 % OF THE TIME

FALL

LOCATION	TEST CONDITION	PERCENTAGE CHANGE	MEAN SPEED (MPH)	SUGGESTED MEAN WIND SPEEDS FOR --------> (MPH): SITTING (5, 10) / 12 STANDING / 15 WALKING / 19 UNCOMFORTABLE FOR WALKING -------> (20, 25+)
37	A		18	***************************
	B		17	*************************
	C	-11	16	***********************
38	A		16	***********************
	B	-12	14	*******************
	C	-12	14	*******************
39	A		15	*********************
	B		16	***********************
	C		16	***********************
40	A		14	*******************
	B	+14	16	***********************
	C		15	*********************
41	A		15	*********************
	B	+26	19	*****************************
	C		15	*********************
42	A		16	***********************
	B	+43	23	*************************************
	C		16	***********************
43	A		16	***********************
	B	-18	13	*****************
	C	-18	13	*****************
44	A		16	***********************
	B	-18	13	*****************
	C	-31	11	*************
45	A		16	***********************
	B	-12	14	*******************
	C	-12	14	*******************
46	A		14	*******************
	B		15	*********************
	C	-35	9	*********
47	A		17	*************************
	B		17	*************************
	C		16	***********************
48	A		17	*************************
	B	+11	19	*****************************
	C	-35	11	*************

NOTE: 1) Final asterisk denotes category of pedestrian activity for which the predicted winds are suitable.
2) % Change greater than 10% based on comparison with Test Condition A.
3) Wind speeds are for a 1% probability.

TEST CONDITION

A	EXISTING SITE CONDITIONS
B	PROPOSED RUGGLES CENTER
C	PROPOSED RUGGLES CENTER WITH REMEDIAL DEVICES

TABLE II D-27

MEAN WIND SPEED EXCEEDED 1 % OF THE TIME

FALL

<------- ACCEPTABLE ------->|<----- UNACCEPTABLE ------->

LOCATION	TEST CONDITION	PERCENTAGE CHANGE	GUST SPEED (MPH)	10 : 20 : 30 : 40 : 50 :
37	A		25	****************
	B		24	***************
	C		23	**************
38	A		23	**************
	B	-13	20	***********
	C		21	************
39	A		21	************
	B		23	**************
	C		23	**************
40	A		20	***********
	B	+15	23	**************
	C	+10	22	*************
41	A		21	************
	B	+23	26	*****************
	C		22	*************
42	A		22	*************
	B	+36	30	*********************
	C		23	**************
43	A		23	**************
	B	-17	19	**********
	C	-13	20	***********
44	A		23	**************
	B	-17	19	**********
	C	-26	17	********
45	A		22	*************
	B		21	************
	C		21	************
46	A		20	***********
	B	+15	23	**************
	C	-20	16	*******
47	A		23	**************
	B		24	***************
	C		23	**************
48	A		23	**************
	B	+13	26	*****************
	C	-26	17	********

NOTE: 1) Final asterisk denotes category of pedestrian activity for which the predicted winds are suitable.
2) % Change greater than 10% based on comparison with Test Condition A.
3) Wind speeds are for a 1% probability.

TEST CONDITION

A	EXISTING SITE CONDITIONS
B	PROPOSED RUGGLES CENTER
C	PROPOSED RUGGLES CENTER WITH REMEDIAL DEVICES

TABLE II D-28

EFFECTIVE GUST SPEED EXCEEDED 1 % OF THE TIME

FALL

SUGGESTED MEAN WIND SPEEDS FOR --------> (MPH): SITTING (up to 12) | STANDING (12–15) | WALKING (15–19) | UNCOMFORTABLE FOR WALKING (19+) -------->

LOCATION	TEST CONDITION	PERCENTAGE CHANGE	MEAN SPEED (MPH)	5 … 10 … 15 … 20 … 25+
49	A		17	*************************
	B		17	*************************
	C	-23	13	*****************
50	A		18	***************************
	B		17	*************************
	C	-27	13	*****************
51	A		17	*************************
	B	+23	21	*********************************
	C		17	*************************
52	A		18	***************************
	B		18	***************************
	C	-11	16	***********************
53	A		21	*********************************
	B	-28	15	*********************
	C	-57	9	*********
54	A		19	*****************************
	B	+21	23	*************************************
	C	-10	17	*************************
55	A		18	***************************
	B		17	*************************
	C	-44	10	***********
56	A		18	***************************
	B	-33	12	***************
	C	-50	9	*********
57	A		17	*************************
	B		17	*************************
	C	-11	15	*********************
58	A		15	*********************
	B	+13	17	*************************
	C	-13	13	*****************
59	A		16	***********************
	B	+18	19	*****************************
	C	-31	11	*************
60	A		18	***************************
	B		17	*************************
	C	-11	16	***********************

NOTE: 1) Final asterisk denotes category of pedestrian activity for which the predicted winds are suitable.
2) % Change greater than 10% based on comparison with Test Condition A.
3) Wind speeds are for a 1% probability.

TEST CONDITION

A EXISTING SITE CONDITIONS
B PROPOSED RUGGLES CENTER
C PROPOSED RUGGLES CENTER WITH REMEDIAL DEVICES

TABLE II D-29

MEAN WIND SPEED EXCEEDED 1 % OF THE TIME

FALL

<------- ACCEPTABLE ------->|<----- UNACCEPTABLE ------->

LOCATION	TEST CONDITION	PERCENTAGE CHANGE	GUST SPEED (MPH)	10 … 20 … 30 … 40 … 50+
49	A		23	**************
	B		24	***************
	C	-21	18	*********
50	A		24	***************
	B		24	***************
	C	-16	20	***********
51	A		23	**************
	B	+30	30	*********************
	C		22	*************
52	A		23	**************
	B		25	****************
	C		22	*************
53	A		27	******************
	B	-18	22	*************
	C	-40	16	*******
54	A		25	****************
	B	+24	31	**********************
	C		24	***************
55	A		24	***************
	B		25	****************
	C	-29	17	********
56	A		24	***************
	B	-25	18	*********
	C	-41	14	*****
57	A		24	***************
	B		25	****************
	C	-12	21	************
58	A		21	************
	B	+19	25	****************
	C		20	***********
59	A		22	*************
	B	+22	27	******************
	C	-18	18	*********
60	A		24	***************
	B		24	***************
	C		22	*************

NOTE: 1) Final asterisk denotes category of pedestrian activity for which the predicted winds are suitable.
2) % Change greater than 10% based on comparison with Test Condition A.
3) Wind speeds are for a 1% probability.

TEST CONDITION

- A EXISTING SITE CONDITIONS
- B PROPOSED RUGGLES CENTER
- C PROPOSED RUGGLES CENTER WITH REMEDIAL DEVICES

TABLE II D-30

EFFECTIVE GUST SPEED EXCEEDED 1 % OF THE TIME

FALL

SUGGESTED MEAN WIND SPEEDS FOR -------->			(MPH)	5 … 12 SITTING	12 … 15 STANDING	15 … 19 WALKING	19 … 25+ UNCOMFORTABLE FOR WALKING ------->
LOCATION	TEST CONDITION	PERCENTAGE CHANGE	MEAN SPEED (MPH)	5 : 10 : 15 : 20 : 25+ :			
1	A		21	*********************************			
	B	+33	28	**+			
	C		19	*****************************			
2	A		23	*************************************			
	B		21	*********************************			
	C	-56	10	***********			
3	A		23	*************************************			
	B	+26	29	**+			
	C	-23	17	*************************			
4	A		23	*************************************			
	B		21	*********************************			
	C		21	*********************************			
5	A		22	***********************************			
	B	+13	25	***			
	C	-31	15	*********************			
6	A		24	***************************************			
	B	+16	28	**+			
	C		23	*************************************			
7	A		23	*************************************			
	B		25	**			
	C	-17	19	*****************************			
8	A		25	***			
	B		26	**+			
	C	-16	21	*********************************			
9	A		23	*************************************			
	B		22	***********************************			
	C		22	***********************************			
10	A		23	*************************************			
	B	-47	12	***************			
	C	-60	9	*********			
11	A		23	*************************************			
	B	-13	20	*******************************			
	C	-13	20	*******************************			
12	A		23	*************************************			
	B	-17	19	*****************************			
	C	-17	19	*****************************			

NOTE: 1) Final asterisk denotes category of pedestrian activity for which the predicted winds are suitable.
2) % Change greater than 10% based on comparison with Test Condition A.
3) Wind speeds are for a 1% probability.

TEST CONDITION

A	EXISTING SITE CONDITIONS
B	PROPOSED RUGGLES CENTER
C	PROPOSED RUGGLES CENTER WITH REMEDIAL DEVICES

TABLE II D-31

MEAN WIND SPEED EXCEEDED 1 % OF THE TIME

WINTER

<------- ACCEPTABLE ------->|<----- UNACCEPTABLE ------->

LOCATION	TEST CONDITION	PERCENTAGE CHANGE	GUST SPEED (MPH)
1	A		29
	B	+31	38
	C	-10	26
2	A		32
	B		30
	C	-50	19
3	A		32
	B	+21	39
	C	-12	28
4	A		30
	B		30
	C		29
5	A		30
	B	+13	34
	C	-30	21
6	A		33
	B	+15	38
	C		31
7	A		32
	B		34
	C		29
8	A		34
	B		35
	C	-11	30
9	A		31
	B		31
	C		31
10	A		31
	B	-35	20
	C	-45	17
11	A		31
	B		28
	C		28
12	A		31
	B	-16	26
	C	-12	27

NOTE: 1) Final asterisk denotes category of pedestrian activity for which the predicted winds are suitable.
2) % Change greater than 10% based on comparison with Test Condition A.
3) Wind speeds are for a 1% probability.

TEST CONDITION

A	EXISTING SITE CONDITIONS
B	PROPOSED RUGGLES CENTER
C	PROPOSED RUGGLES CENTER WITH REMEDIAL DEVICES

TABLE II D-32

EFFECTIVE GUST SPEED EXCEEDED 1 % OF THE TIME

WINTER

SUGGESTED MEAN WIND SPEEDS FOR --------> (MPH) SITTING | 12 | STANDING | 15 | WALKING | 19 | UNCOMFORTABLE FOR WALKING ------->

LOCATION	TEST CONDITION	PERCENTAGE CHANGE	MEAN SPEED (MPH)	5 : 10 : 15 : 20 : 25+
13	A		23	*************************************
	B		21	*********************************
	C	-17	19	*****************************
14	A		23	*************************************
	B		24	***************************************
	C		22	***********************************
15	A		22	***********************************
	B		24	***************************************
	C		24	***************************************
16	A		27	**+
	B		25	***
	C	-11	24	***************************************
17	A		23	*************************************
	B		22	***********************************
	C		21	*********************************
18	A		23	*************************************
	B	-13	20	*******************************
	C	-17	19	*****************************
19	A		23	*************************************
	B		24	***************************************
	C		21	*********************************
20	A		24	***************************************
	B	+12	27	**+
	C	-16	20	*******************************
21	A		24	***************************************
	B		24	***************************************
	C	-50	12	***************
22	A		24	***************************************
	B		25	***
	C	-54	11	*************
23	A		23	*************************************
	B	+21	28	**+
	C	-26	17	*************************
24	A		23	*************************************
	B	+30	30	**+
	C	-43	13	*****************

NOTE: 1) Final asterisk denotes category of pedestrian activity for which the predicted winds are suitable.
2) % Change greater than 10% based on comparison with Test Condition A.
3) Wind speeds are for a 1% probability.

TEST CONDITION

A	EXISTING SITE CONDITIONS
B	PROPOSED RUGGLES CENTER
C	PROPOSED RUGGLES CENTER WITH REMEDIAL DEVICES

TABLE II D-33

MEAN WIND SPEED EXCEEDED 1 % OF THE TIME

WINTER

LOCATION	TEST CONDITION	PERCENTAGE CHANGE	GUST SPEED (MPH)	<------- ACCEPTABLE -------->|<------ UNACCEPTABLE -------> 10 : 20 : 30 : 40 : 50+ :
13	A		31	**********************
	B		28	*******************
	C	-16	26	*****************
14	A		31	**********************
	B		31	**********************
	C		30	*********************
15	A		32	***********************
	B		35	**************************
	C		35	**************************
16	A		35	**************************
	B		36	***************************
	C		35	**************************
17	A		31	**********************
	B		31	**********************
	C		30	*********************
18	A		31	**********************
	B		30	*********************
	C		30	*********************
19	A		31	**********************
	B		33	************************
	C		28	*******************
20	A		32	***********************
	B	+18	38	*****************************
	C	-15	27	******************
21	A		31	**********************
	B		34	*************************
	C	-41	18	*********
22	A		32	***********************
	B		33	************************
	C	-43	18	*********
23	A		31	**********************
	B	+19	37	****************************
	C	-12	27	******************
24	A		31	**********************
	B	+32	41	********************************
	C	-38	19	**********

NOTE: 1) Final asterisk denotes category of pedestrian activity for which the predicted winds are suitable.
2) % Change greater than 10% based on comparison with Test Condition A.
3) Wind speeds are for a 1% probability.

TEST CONDITION

A	EXISTING SITE CONDITIONS
B	PROPOSED RUGGLES CENTER
C	PROPOSED RUGGLES CENTER WITH REMEDIAL DEVICES

TABLE II D-34

EFFECTIVE GUST SPEED EXCEEDED 1 % OF THE TIME

WINTER

SUGGESTED MEAN WIND SPEEDS FOR --------> (MPH)

SITTING (up to 12) | STANDING (12–15) | WALKING (15–19) | UNCOMFORTABLE FOR WALKING (19+) ------->

LOCATION	TEST CONDITION	PERCENTAGE CHANGE	MEAN SPEED (MPH)	5 · 10 · 15 · 20 · 25+
25	A		23	*************************************
	B	+21	28	**+
	C	-13	20	*******************************
26	A		23	*************************************
	B		24	***************************************
	C	-21	18	***************************
27	A		23	*************************************
	B		24	***************************************
	C	-30	16	***********************
28	A		23	*************************************
	B	+17	27	**+
	C	-34	15	*********************
29	A		23	*************************************
	B	+30	30	**+
	C	-34	15	*********************
30	A		22	***********************************
	B	+31	29	**+
	C	-27	16	***********************
31	A		23	*************************************
	B	-21	18	***************************
	C	-26	17	*************************
32	A		24	***************************************
	B	-29	17	*************************
	C	-41	14	*******************
33	A		22	***********************************
	B	-18	18	***************************
	C	-22	17	*************************
34	A		22	***********************************
	B	+18	26	**+
	C		24	***************************************
35	A		24	***************************************
	B		23	*************************************
	C		22	***********************************
36	A		26	**+
	B	-23	20	*******************************
	C	-23	20	*******************************

NOTE: 1) Final asterisk denotes category of pedestrian activity for which the predicted winds are suitable.
2) % Change greater than 10% based on comparison with Test Condition A.
3) Wind speeds are for a 1% probability.

TEST CONDITION

A	EXISTING SITE CONDITIONS
B	PROPOSED RUGGLES CENTER
C	PROPOSED RUGGLES CENTER WITH REMEDIAL DEVICES

TABLE II D-35

MEAN WIND SPEED EXCEEDED 1 % OF THE TIME

WINTER

<------- ACCEPTABLE ------->|<------ UNACCEPTABLE ------->

LOCATION	TEST CONDITION	PERCENTAGE CHANGE	GUST SPEED (MPH)	10 : 20 : 30 :¦ 40 : 50¦
25	A		30	*********************
	B	+26	38	*****************************
	C		30	*********************
26	A		30	*********************
	B		32	***********************
	C	-16	25	****************
27	A		31	**********************
	B		32	***********************
	C	-25	23	**************
28	A		31	**********************
	B	+12	35	**************************
	C	-22	24	***************
29	A		31	**********************
	B	+22	38	*****************************
	C	-29	22	*************
30	A		30	*********************
	B	+23	37	****************************
	C	-23	23	**************
31	A		31	**********************
	B	-16	26	*****************
	C	-22	24	***************
32	A		32	***********************
	B	-25	24	***************
	C	-31	22	*************
33	A		31	**********************
	B	-12	27	******************
	C	-16	26	*****************
34	A		30	*********************
	B	+16	35	**************************
	C		32	***********************
35	A		33	************************
	B		34	*************************
	C		33	************************
36	A		34	*************************
	B	-11	30	*********************
	C	-11	30	*********************

NOTE: 1) Final asterisk denotes category of pedestrian activity
for which the predicted winds are suitable.
2) % Change greater than 10% based on comparison with Test Condition A.
3) Wind speeds are for a 1% probability.

TEST CONDITION

A	EXISTING SITE CONDITIONS
B	PROPOSED RUGGLES CENTER
C	PROPOSED RUGGLES CENTER WITH REMEDIAL DEVICES

TABLE II D-36

EFFECTIVE GUST SPEED EXCEEDED 1 % OF THE TIME

WINTER

SUGGESTED MEAN WIND SPEEDS FOR (MPH) --------> SITTING | 12 | STANDING | 15 | WALKING | 19 | UNCOMFORTABLE FOR WALKING -------->

LOCATION	TEST CONDITION	PERCENTAGE CHANGE	MEAN SPEED (MPH)	5 : 10 : 12 : 15 : 19 : 20 : 25+
37	A		24	***************************************
	B	-20	19	*****************************
	C	-25	18	***************************
38	A		20	*******************************
	B	-15	17	*************************
	C	-15	17	*************************
39	A		19	*****************************
	B		19	*****************************
	C		19	*****************************
40	A		19	*****************************
	B		20	*******************************
	C		19	*****************************
41	A		18	***************************
	B	+38	25	***
	C		19	*****************************
42	A		20	*******************************
	B	+55	31	**+
	C	-10	18	***************************
43	A		20	*******************************
	B	-15	17	*************************
	C	-20	16	***********************
44	A		21	*********************************
	B	-19	17	*************************
	C	-33	14	*******************
45	A		19	*****************************
	B	-10	17	*************************
	C		18	***************************
46	A		16	***********************
	B	+18	19	*****************************
	C	-31	11	*************
47	A		20	*******************************
	B		20	*******************************
	C		20	*******************************
48	A		20	*******************************
	B	+10	22	***********************************
	C	-20	16	***********************

NOTE: 1) Final asterisk denotes category of pedestrian activity for which the predicted winds are suitable.
2) % Change greater than 10% based on comparison with Test Condition A.
3) Wind speeds are for a 1% probability.

TEST CONDITION

A EXISTING SITE CONDITIONS
B PROPOSED RUGGLES CENTER
C PROPOSED RUGGLES CENTER WITH REMEDIAL DEVICES

TABLE II D-37

MEAN WIND SPEED EXCEEDED 1 % OF THE TIME

WINTER

LOCATION	TEST CONDITION	PERCENTAGE CHANGE	GUST SPEED (MPH)	<------- ACCEPTABLE ------->|<------ UNACCEPTABLE -------> 10 : 20 : 30 : | 40 : 50+ :
37	A		32	***********************
	B	-15	27	******************
	C	-18	26	*****************
38	A		28	*******************
	B	-10	25	****************
	C	-10	25	****************
39	A		26	*****************
	B		27	******************
	C		27	******************
40	A		26	*****************
	B	+11	29	********************
	C		27	******************
41	A		26	*****************
	B	+30	34	*************************
	C		27	******************
42	A		28	*******************
	B	+39	39	******************************
	C		26	*****************
43	A		29	********************
	B	-17	24	***************
	C	-17	24	***************
44	A		29	********************
	B	-17	24	***************
	C	-27	21	************
45	A		26	*****************
	B		25	****************
	C		26	*****************
46	A		23	**************
	B	+26	29	********************
	C	-17	19	**********
47	A		28	*******************
	B		29	********************
	C		28	*******************
48	A		27	******************
	B	+14	31	**********************
	C	-14	23	**************

NOTE: 1) Final asterisk denotes category of pedestrian activity for which the predicted winds are suitable.
2) % Change greater than 10% based on comparison with Test Condition A.
3) Wind speeds are for a 1% probability.

TEST CONDITION

A EXISTING SITE CONDITIONS
B PROPOSED RUGGLES CENTER
C PROPOSED RUGGLES CENTER WITH REMEDIAL DEVICES

TABLE II D-38

EFFECTIVE GUST SPEED EXCEEDED 1 % OF THE TIME

WINTER

SUGGESTED MEAN WIND SPEEDS FOR --------> (MPH)

SITTING (to 12)	STANDING (12–15)	WALKING (15–19)	UNCOMFORTABLE FOR WALKING -------> (19+)

LOCATION	TEST CONDITION	PERCENTAGE CHANGE	MEAN SPEED (MPH)	5 : 10 : 15 : 20 : 25+
49	A		20	*******************************
	B		20	*******************************
	C	-10	18	***************************
50	A		20	*******************************
	B		21	*********************************
	C	-15	17	*************************
51	A		21	*********************************
	B	+38	29	**+
	C	+14	24	***************************************
52	A		21	*********************************
	B	+14	24	***************************************
	C		20	*******************************
53	A		24	***************************************
	B	-25	18	***************************
	C	-50	12	***************
54	A		23	*************************************
	B	+34	31	**+
	C		22	***********************************
55	A		22	***********************************
	B		23	*************************************
	C	-45	12	***************
56	A		22	***********************************
	B	-31	15	*********************
	C	-50	11	*************
57	A		21	*********************************
	B		21	*********************************
	C		20	*******************************
58	A		18	***************************
	B		19	*****************************
	C	-22	14	*******************
59	A		19	*****************************
	B	+15	22	***********************************
	C	-36	12	***************
60	A		21	*********************************
	B		22	***********************************
	C		20	*******************************

NOTE: 1) Final asterisk denotes category of pedestrian activity for which the predicted winds are suitable.
2) % Change greater than 10% based on comparison with Test Condition A.
3) Wind speeds are for a 1% probability.

TEST CONDITION

A	EXISTING SITE CONDITIONS
B	PROPOSED RUGGLES CENTER
C	PROPOSED RUGGLES CENTER WITH REMEDIAL DEVICES

TABLE II D-39

MEAN WIND SPEED EXCEEDED 1 % OF THE TIME

WINTER

<------- ACCEPTABLE ------->|<----- UNACCEPTABLE ------->

LOCATION	TEST CONDITION	PERCENTAGE CHANGE	GUST SPEED (MPH)	10 : 20 : 30 : 40 : 50+
49	A		28	*******************
	B		29	********************
	C	-10	25	****************
50	A		28	*******************
	B		30	*********************
	C	-10	25	****************
51	A		28	*******************
	B	+39	39	******************************
	C		30	*********************
52	A		29	********************
	B	+13	33	************************
	C		29	********************
53	A		32	***********************
	B	-15	27	******************
	C	-37	20	***********
54	A		30	*********************
	B	+36	41	********************************
	C		32	***********************
55	A		30	*********************
	B	+13	34	*************************
	C	-33	20	***********
56	A		30	*********************
	B	-23	23	**************
	C	-36	19	**********
57	A		29	********************
	B	+10	32	***********************
	C		28	*******************
58	A		26	*****************
	B	+11	29	********************
	C	-15	22	*************
59	A		27	******************
	B	+18	32	***********************
	C	-25	20	***********
60	A		29	********************
	B		31	**********************
	C		28	*******************

NOTE: 1) Final asterisk denotes category of pedestrian activity for which the predicted winds are suitable.
2) % Change greater than 10% based on comparison with Test Condition A.
3) Wind speeds are for a 1% probability.

TEST CONDITION

A	EXISTING SITE CONDITIONS
B	PROPOSED RUGGLES CENTER
C	PROPOSED RUGGLES CENTER WITH REMEDIAL DEVICES

TABLE II D-40

EFFECTIVE GUST SPEED EXCEEDED 1 % OF THE TIME

WINTER

SUGGESTED MEAN WIND SPEEDS FOR --------> (MPH): SITTING | 12 | STANDING | 15 | WALKING | 19 | UNCOMFORTABLE FOR WALKING ------->

LOCATION	TEST CONDITION	PERCENTAGE CHANGE	MEAN SPEED (MPH)	5 : . . . 10 : . . . 15 : . . . 20 : . . . 25+ :
1	A		18	***************************
	B	+27	23	*************************************
	C	-11	16	***********************
2	A		19	*****************************
	B	-15	16	***********************
	C	-58	8	*******
3	A		20	*******************************
	B	+15	23	*************************************
	C	-30	14	*******************
4	A		19	*****************************
	B	-10	17	*************************
	C	-10	17	*************************
5	A		18	***************************
	B	+11	20	*******************************
	C	-33	12	***************
6	A		20	*******************************
	B	+10	22	***********************************
	C	-10	18	***************************
7	A		19	*****************************
	B		20	*******************************
	C	-15	16	***********************
8	A		20	*******************************
	B		21	*********************************
	C	-15	17	*************************
9	A		19	*****************************
	B		18	***************************
	C	-10	17	*************************
10	A		20	*******************************
	B	-50	10	***********
	C	-60	8	*******
11	A		19	*****************************
	B	-10	17	*************************
	C	-10	17	*************************
12	A		19	*****************************
	B	-15	16	***********************
	C	-15	16	***********************

NOTE: 1) Final asterisk denotes category of pedestrian activity for which the predicted winds are suitable.
2) % Change greater than 10% based on comparison with Test Condition A.
3) Wind speeds are for a 1% probability.

TEST CONDITION

A	EXISTING SITE CONDITIONS
B	PROPOSED RUGGLES CENTER
C	PROPOSED RUGGLES CENTER WITH REMEDIAL DEVICES

TABLE II D-41

MEAN WIND SPEED EXCEEDED 1 % OF THE TIME

ANNUAL

<------- ACCEPTABLE ------->I<----- UNACCEPTABLE ------->

LOCATION	TEST CONDITION	PERCENTAGE CHANGE	GUST SPEED (MPH)	10 : 20 : 30 : I 40 : 50+ :
1	A		24	***************
	B	+29	31	**********************
	C		22	*************
2	A		26	*****************
	B	-11	23	**************
	C	-38	16	*******
3	A		26	*****************
	B	+19	31	**********************
	C	-11	23	**************
4	A		25	****************
	B		24	***************
	C		24	***************
5	A		25	****************
	B		27	******************
	C	-28	18	*********
6	A		27	******************
	B	+11	30	*********************
	C		25	****************
7	A		26	*****************
	B		27	******************
	C	-11	23	**************
8	A		28	*******************
	B		28	*******************
	C	-10	25	****************
9	A		25	****************
	B		25	****************
	C		25	****************
10	A		26	*****************
	B	-34	17	********
	C	-42	15	******
11	A		26	*****************
	B		25	****************
	C		25	****************
12	A		26	*****************
	B	-15	22	*************
	C	-11	23	**************

NOTE: 1) Final asterisk denotes category of pedestrian activity
for which the predicted winds are suitable.
2) % Change greater than 10% based on comparison with Test Condition A.
3) Wind speeds are for a 1% probability.

TEST CONDITION

A	EXISTING SITE CONDITIONS
B	PROPOSED RUGGLES CENTER
C	PROPOSED RUGGLES CENTER WITH REMEDIAL DEVICES

TABLE II D-42

EFFECTIVE GUST SPEED EXCEEDED 1 % OF THE TIME

ANNUAL

SUGGESTED MEAN WIND SPEEDS FOR --------> (MPH)

				5 ... 10 ... 12 SITTING / STANDING 15 / WALKING 19 / UNCOMFORTABLE FOR WALKING --------> 20 ... 25+
LOCATION	TEST CONDITION	PERCENTAGE CHANGE	MEAN SPEED (MPH)	5 : 10 : 12 ¦ 15 ¦ 19 ¦ 20 : 25+ :
13	A		19	*****************************
	B		19	*****************************
	C	-15	16	***********************
14	A		19	*****************************
	B		20	*******************************
	C		18	***************************
15	A		18	***************************
	B	+11	20	*******************************
	C		19	*****************************
16	A		21	*********************************
	B		20	*******************************
	C	-10	19	*****************************
17	A		19	*****************************
	B		18	***************************
	C	-10	17	*************************
18	A		18	***************************
	B		17	*************************
	C	-11	16	***********************
19	A		19	*****************************
	B		19	*****************************
	C	-10	17	*************************
20	A		20	*******************************
	B	+15	23	*************************************
	C	-15	17	*************************
21	A		20	*******************************
	B		20	*******************************
	C	-45	11	*************
22	A		20	*******************************
	B		20	*******************************
	C	-55	9	*********
23	A		20	*******************************
	B	+15	23	*************************************
	C	-30	14	*******************
24	A		19	*****************************
	B	+31	25	***************************************+
	C	-36	12	***************

NOTE: 1) Final asterisk denotes category of pedestrian activity for which the predicted winds are suitable.
2) % Change greater than 10% based on comparison with Test Condition A.
3) Wind speeds are for a 1% probability.

TEST CONDITION

A	EXISTING SITE CONDITIONS
B	PROPOSED RUGGLES CENTER
C	PROPOSED RUGGLES CENTER WITH REMEDIAL DEVICES

TABLE II D-43

MEAN WIND SPEED EXCEEDED 1 % OF THE TIME

ANNUAL

<------- ACCEPTABLE ------->|<----- UNACCEPTABLE ------->

LOCATION	TEST CONDITION	PERCENTAGE CHANGE	GUST SPEED (MPH)	10 : 20 : 30 : 40 : 50+
13	A		26	*****************
	B		25	****************
	C	-11	23	**************
14	A		25	****************
	B		26	*****************
	C		25	****************
15	A		26	*****************
	B		28	*******************
	C		28	*******************
16	A		28	*******************
	B		29	********************
	C		28	*******************
17	A		26	*****************
	B		26	*****************
	C		25	****************
18	A		25	****************
	B		25	****************
	C		25	****************
19	A		26	*****************
	B		28	*******************
	C	-11	23	**************
20	A		27	******************
	B	+14	31	**********************
	C	-14	23	**************
21	A		26	*****************
	B		28	*******************
	C	-38	16	*******
22	A		26	*****************
	B		27	******************
	C	-46	14	*****
23	A		26	*****************
	B	+19	31	**********************
	C	-19	21	************
24	A		26	*****************
	B	+26	33	************************
	C	+34	17	********

NOTE: 1) Final asterisk denotes category of pedestrian activity for which the predicted winds are suitable.
2) % Change greater than 10% based on comparison with Test Condition A.
3) Wind speeds are for a 1% probability.

TEST CONDITION

A EXISTING SITE CONDITIONS
B PROPOSED RUGGLES CENTER
C PROPOSED RUGGLES CENTER WITH REMEDIAL DEVICES

TABLE II D-44

EFFECTIVE GUST SPEED EXCEEDED 1 % OF THE TIME

ANNUAL

SUGGESTED MEAN WIND SPEEDS FOR --------> (MPH): SITTING (up to 12) | STANDING (12–15) | WALKING (15–19) | UNCOMFORTABLE FOR WALKING -------> (19+)

Scale: 5, 10, 15, 20, 25+

LOCATION	TEST CONDITION	PERCENTAGE CHANGE	MEAN SPEED (MPH)
25	A		19
	B	+15	22
	C	-15	16
26	A		19
	B		20
	C	-31	14
27	A		19
	B	+10	21
	C	-31	13
28	A		19
	B	+15	22
	C	-31	13
29	A		19
	B	+31	25
	C	-26	14
30	A		19
	B	+26	24
	C	-21	15
31	A		19
	B	-15	16
	C	-21	15
32	A		19
	B	-21	15
	C	-31	13
33	A		18
	B	-11	16
	C	-16	15
34	A		18
	B	+22	22
	C	+11	20
35	A		19
	B		19
	C		18
36	A		21
	B	-23	16
	C	-23	16

NOTE: 1) Final asterisk denotes category of pedestrian activity for which the predicted winds are suitable.
2) % Change greater than 10% based on comparison with Test Condition A.
3) Wind speeds are for a 1% probability.

TEST CONDITION

A	EXISTING SITE CONDITIONS
B	PROPOSED RUGGLES CENTER
C	PROPOSED RUGGLES CENTER WITH REMEDIAL DEVICES

TABLE II D-45

MEAN WIND SPEED EXCEEDED 1 % OF THE TIME

ANNUAL

LOCATION	TEST CONDITION	PERCENTAGE CHANGE	GUST SPEED (MPH)	<------- ACCEPTABLE --------->|<----- UNACCEPTABLE --------> 10 : 20 : 30 :	40 : 50+ :
25	A		25	****************
	B	+24	31	**********************
	C		25	****************
26	A		25	****************
	B		27	******************
	C	-20	20	***********
27	A		26	*****************
	B		28	*******************
	C	-26	19	**********
28	A		26	*****************
	B	+11	29	********************
	C	-26	19	**********
29	A		26	*****************
	B	+19	31	**********************
	C	-26	19	**********
30	A		25	****************
	B	+20	30	*********************
	C	-20	20	***********
31	A		26	*****************
	B	-11	23	**************
	C	-19	21	************
32	A		26	*****************
	B	-19	21	************
	C	-26	19	**********
33	A		25	****************
	B		24	***************
	C		23	**************
34	A		25	****************
	B	+20	30	*********************
	C		27	******************
35	A		27	******************
	B		28	*******************
	C		27	******************
36	A		27	******************
	B	-11	24	***************
	C		25	****************

NOTE: 1) Final asterisk denotes category of pedestrian activity for which the predicted winds are suitable.
2) % Change greater than 10% based on comparison with Test Condition A.
3) Wind speeds are for a 1% probability.

TEST CONDITION

A EXISTING SITE CONDITIONS
B PROPOSED RUGGLES CENTER
C PROPOSED RUGGLES CENTER WITH REMEDIAL DEVICES

TABLE II D-46

EFFECTIVE GUST SPEED EXCEEDED 1 % OF THE TIME

ANNUAL

LOCATION	TEST CONDITION	PERCENTAGE CHANGE	MEAN SPEED (MPH)	SUGGESTED MEAN WIND SPEEDS FOR (MPH): SITTING (5–12) / STANDING (12–15) / WALKING (15–19) / UNCOMFORTABLE FOR WALKING (19–25+)
37	A		19	*****************************
	B	-15	16	***********************
	C	-15	16	***********************
38	A		17	*************************
	B	-17	14	*******************
	C	-17	14	*******************
39	A		16	***********************
	B		16	***********************
	C		16	***********************
40	A		15	*********************
	B		16	***********************
	C		15	*********************
41	A		16	***********************
	B	+25	20	*******************************
	C		16	***********************
42	A		17	*************************
	B	+47	25	***************************************+
	C		16	***********************
43	A		17	*************************
	B	-23	13	*****************
	C	-23	13	*****************
44	A		17	*************************
	B	-23	13	*****************
	C	-35	11	*************
45	A		16	***********************
	B	-12	14	*******************
	C		15	*********************
46	A		14	*******************
	B	+14	16	***********************
	C	-35	9	*********
47	A		17	*************************
	B		17	*************************
	C		16	***********************
48	A		17	*************************
	B	+11	19	*****************************
	C	-23	13	*****************

NOTE: 1) Final asterisk denotes category of pedestrian activity for which the predicted winds are suitable.
2) % Change greater than 10% based on comparison with Test Condition A.
3) Wind speeds are for a 1% probability.

TEST CONDITION

- A EXISTING SITE CONDITIONS
- B PROPOSED RUGGLES CENTER
- C PROPOSED RUGGLES CENTER WITH REMEDIAL DEVICES

TABLE II D-47

MEAN WIND SPEED EXCEEDED 1 % OF THE TIME

ANNUAL

<------- ACCEPTABLE ------->|<----- UNACCEPTABLE ------->

LOCATION	TEST CONDITION	PERCENTAGE CHANGE	GUST SPEED (MPH)	10 : 20 : 30 : 40 : 50+
37	A		26	*****************
	B		24	***************
	C	-11	23	**************
38	A		23	**************
	B		21	************
	C		21	************
39	A		22	*************
	B		23	**************
	C		23	**************
40	A		21	************
	B	+14	24	***************
	C		22	*************
41	A		22	*************
	B	+27	28	*******************
	C		22	*************
42	A		23	**************
	B	+39	32	***********************
	C		23	**************
43	A		24	***************
	B	-20	19	**********
	C	-16	20	***********
44	A		24	***************
	B	-16	20	***********
	C	-29	17	********
45	A		22	*************
	B		21	************
	C		22	*************
46	A		20	***********
	B	+20	24	***************
	C	-20	16	*******
47	A		24	***************
	B		25	****************
	C		23	**************
48	A		23	**************
	B	+13	26	*****************
	C	-17	19	**********

NOTE: 1) Final asterisk denotes category of pedestrian activity for which the predicted winds are suitable.
2) % Change greater than 10% based on comparison with Test Condition A.
3) Wind speeds are for a 1% probability.

TEST CONDITION

A EXISTING SITE CONDITIONS
B PROPOSED RUGGLES CENTER
C PROPOSED RUGGLES CENTER WITH REMEDIAL DEVICES

TABLE II D-48

EFFECTIVE GUST SPEED EXCEEDED 1 % OF THE TIME

ANNUAL

SUGGESTED MEAN WIND SPEEDS FOR --------> (MPH): SITTING (below 12) | 12 STANDING | 15 WALKING | 19 UNCOMFORTABLE FOR WALKING ------->

Scale: 5 · 10 · 15 · 20 · 25+

LOCATION	TEST CONDITION	PERCENTAGE CHANGE	MEAN SPEED (MPH)	5 ... 10 ... 15 ... 20 ... 25+
49	A		17	*************************
	B		17	*************************
	C	-17	14	*******************
50	A		18	***************************
	B		17	*************************
	C	-22	14	*******************
51	A		17	*************************
	B	+35	23	*************************************
	C	+11	19	*****************************
52	A		18	***************************
	B		19	*****************************
	C		17	*************************
53	A		20	*******************************
	B	-25	15	*********************
	C	-50	10	***********
54	A		19	*****************************
	B	+31	25	**+
	C		18	***************************
55	A		19	*****************************
	B		19	*****************************
	C	-42	11	*************
56	A		18	***************************
	B	-27	13	*****************
	C	-50	9	*********
57	A		18	***************************
	B		17	*************************
	C	-11	16	***********************
58	A		15	*********************
	B	+13	17	*************************
	C	-13	13	*****************
59	A		16	***********************
	B	+18	19	*****************************
	C	-31	11	*************
60	A		18	***************************
	B		18	***************************
	C	-11	16	***********************

NOTE: 1) Final asterisk denotes category of pedestrian activity for which the predicted winds are suitable.
2) % Change greater than 10% based on comparison with Test Condition A.
3) Wind speeds are for a 1% probability.

TEST CONDITION

A	EXISTING SITE CONDITIONS
B	PROPOSED RUGGLES CENTER
C	PROPOSED RUGGLES CENTER WITH REMEDIAL DEVICES

TABLE II D-49

MEAN WIND SPEED EXCEEDED 1 % OF THE TIME

ANNUAL

LOCATION	TEST CONDITION	PERCENTAGE CHANGE	GUST SPEED (MPH)	<------- ACCEPTABLE ------->|<----- UNACCEPTABLE -------> (10 : 20 : 30 : 40 : 50+)
49	A		23	**************
	B		24	***************
	C	-13	20	***********
50	A		24	***************
	B		25	****************
	C	-12	21	************
51	A		24	***************
	B	+33	32	***********************
	C		24	***************
52	A		24	***************
	B	+12	27	******************
	C		24	***************
53	A		27	******************
	B	-14	23	**************
	C	-40	16	*******
54	A		26	*****************
	B	+26	33	************************
	C		26	*****************
55	A		25	****************
	B		27	******************
	C	-32	17	********
56	A		25	****************
	B	-24	19	**********
	C	-40	15	******
57	A		24	***************
	B		26	*****************
	C		23	**************
58	A		22	*************
	B	+13	25	****************
	C		20	***********
59	A		23	**************
	B	+17	27	******************
	C	-21	18	*********
60	A		24	***************
	B		25	****************
	C		23	**************

NOTE: 1) Final asterisk denotes category of pedestrian activity for which the predicted winds are suitable.
2) % Change greater than 10% based on comparison with Test Condition A.
3) Wind speeds are for a 1% probability.

TEST CONDITION

A EXISTING SITE CONDITIONS
B PROPOSED RUGGLES CENTER
C PROPOSED RUGGLES CENTER WITH REMEDIAL DEVICES

TABLE II D-50

EFFECTIVE GUST SPEED EXCEEDED 1 % OF THE TIME

ANNUAL

E. Open Space

Design Considerations

Certain important open space considerations underlie the design of Ruggles Center and are reflected in the Master Plan Design.

- Continuity with the Southwest Corridor Park (SWCP) is maintained.
- The MBTA Parkland is well integrated with landscape elements in the Ruggles Center complex.
- Safe pedestrian access to Ruggles Street Station and the surrounding community is established.
- Clearly marked bikeways enable cyclists to safely cross Ruggles Center and continue on along the SWCP.
- Play areas for on-site day care facilities are secure and shielded from wind, noise and traffic.
- Landscape elements are used to improve adverse localized wind or noise situations.
- Landscape elements complement the building design and contribute to the overall coherence of the Ruggles Center development and connection to the surrounding neighborhoods.

Existing Open Space Recreational Resources

Several excellent recreational areas are located in the immediate area (See Figure II E-1) and provide a larger context for the types of open space planned for Ruggles Center. Close by, the Madison Park High School playfields and the William E. Carter Playground, renovated in 1986, offer facilities for field and court sports. An open space/ seating area west of St. Cyprian's Church provides 15,000 sq. ft. of open space along Melnea Cass Boulevard for neighborhood residents. North of the site across Huntington Avenue is the Back Bay Fens, a heavily-used regional park that is a major link in Boston's Emerald Necklace Park system. Here, there are fields for baseball, football, and soccer, as well as a small grandstand for spectators. Community gardening plots, a rose garden, landscaped walking paths, and numerous seating areas are situated throughout the Fens.

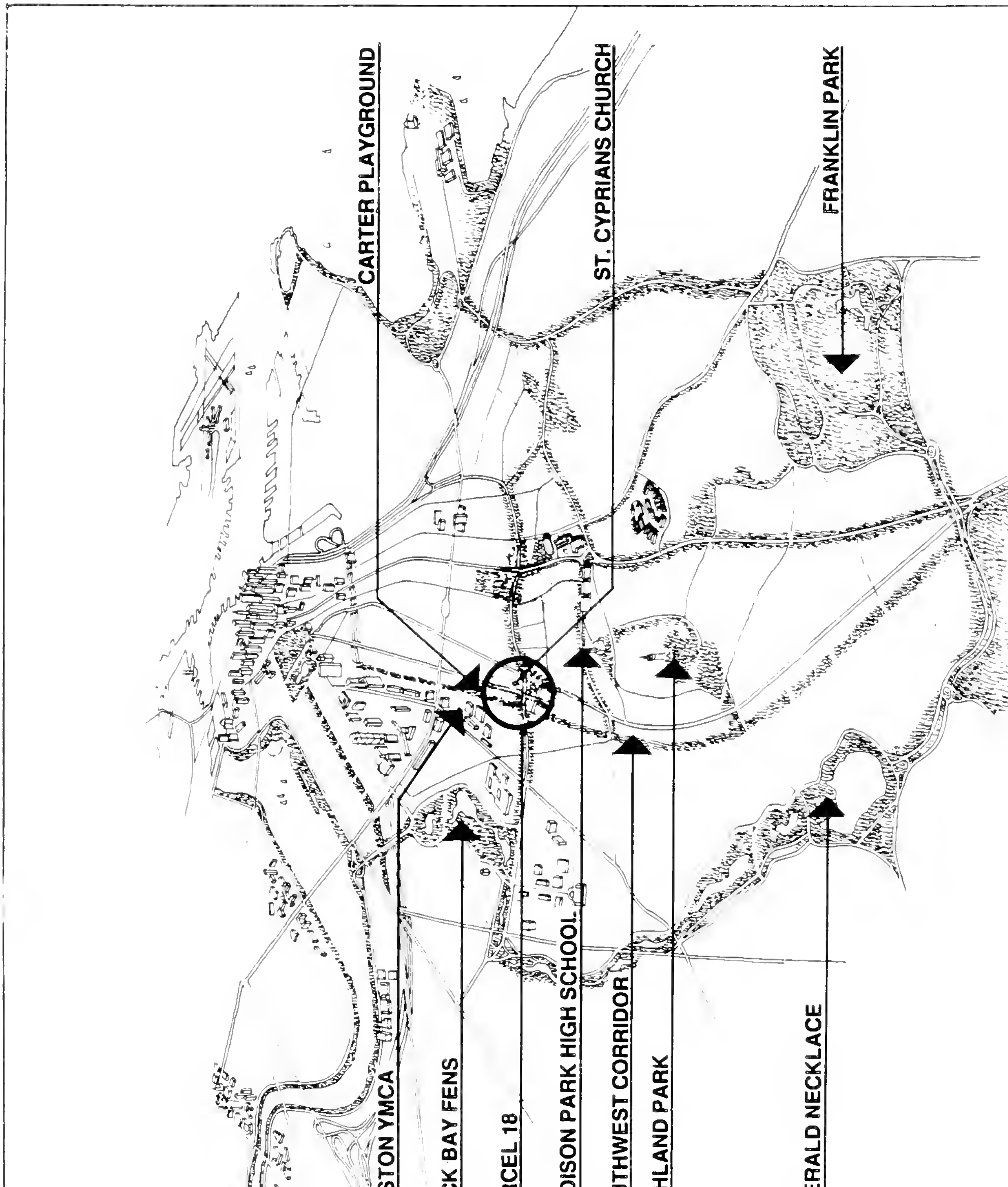


Figure II E-1: Existing Open Space and Recreational Resources

In addition, the MBTA has recently completed the Southwest Corridor Park. This park is the newest and most extensive recreational resource available in the neighborhood. The SWCP is 4.7 miles long and is a linear park which runs along the relocated MBTA Orange Line transit corridor. The SWCP also acts as a continuous greenbelt between the Forest Hills MBTA Station and the Back Bay MBTA Station. One of the largest segments of the SWCP is located directly southwest of Ruggles Center across Ruggles Street. Here, tennis and basketball courts, an outdoor amphitheater, landscaped open space, and seating areas are available to local residents. The SWCP also functions as a major pedestrian and bicycle corridor with the provision for walking paths and bike lanes.

The Boston YMCA on Huntington Avenue provides the community with indoor recreational facilities. Other nearby facilities include the Boys and Girls Club of Roxbury near Dudley Square and the gymnasium at Madison Park High School. A joint Northeastern University Recreation Center / Schoolboy Track facility is proposed for Parcel 17X, adjacent to and northeast of the site. This facility will be open to the community.

Open Space Elements Master Plan Design

Access and Continuity

The Master Plan Design maintains the continuity of the linear Southwest Corridor Park system (SWCP) with unrestricted, multiple access points as it passes through Ruggles Center. (See Figure II E-2.) From the north, the SWCP crosses the Melnea Cass / Columbus Avenue intersection and enters the site on the west side of the Columbus Avenue extension as a thirty-foot wide, paved pedestrian/bikeway. This pedestrian/bikeway continues across the site to the entrance of Ruggles Station. This portion of the SWCP will include landscaping elements similar to the rest of the site (level brick and granite walkways; benches; tree plantings; etc.) In order to minimize potential conflicts between pedestrians and cyclists, the paved area at this point may be designated with signage or other visual markers restricting cyclists to the portion closest to the street. Only one curb cut for auto access into the adjacent garage is being proposed in this area.

Midway through the site, in front of Ruggles Station, the SWCP will intersect the new public plaza, offering users direct access to the station as well as the plaza. Parkland users, commuters, workers and neighborhood residents will be able to directly access Tremont Street through the plaza itself or on sidewalks to either side.

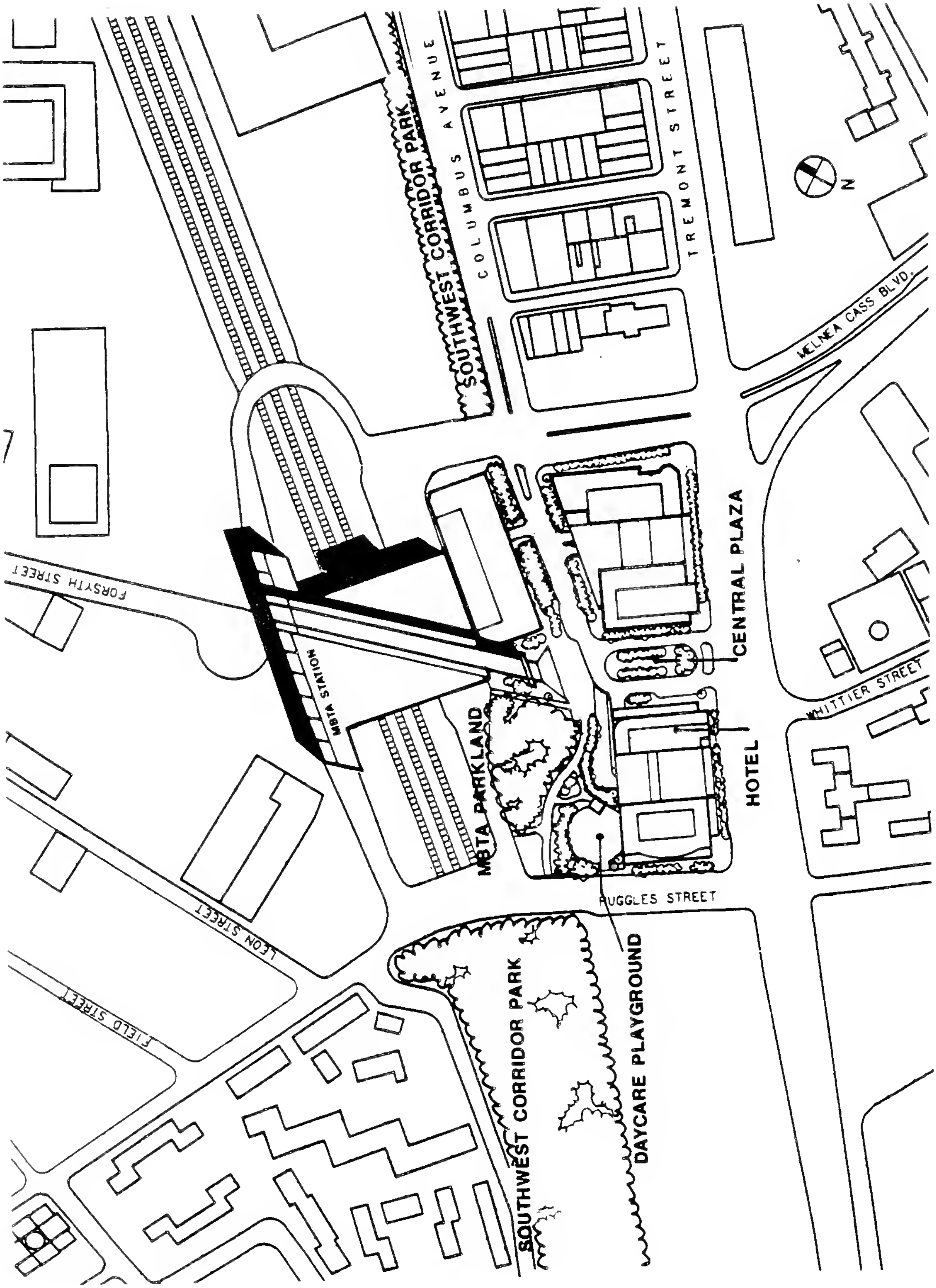


Figure II E-2: Open Space for Master Plan Design

From the station entry south, the SWCP will continue across the remainder of the site to Ruggles Street. It becomes an expansive landscaped area at this point, with a continuation of the paved walkway. Except for the addition of certain landscape features, this portion of the SWCP will be largely undisturbed by new development on the site. The SWCP will continue across Ruggles Street to connect to the remainder of the linear park system.

Landscape Elements

Every portion of open space on the development parcel will receive new landscape elements. (See Figure II E-3.) All sidewalks adjacent to proposed buildings will be constructed of "traditional" materials: brick pavers with granite and concrete accents and various species of trees set in metal gratings. Sidewalks will be a minimum of fifteen feet in width where they abut adjacent streets and will connect directly to existing neighborhood walks and the SWCP. The major open space element being proposed, the public plaza, will likewise be constructed of "traditional" materials and will be accented by a fountain, flagpoles, a commemorative statue or sculpture and extensive vegetation, seating and lighting throughout. The expansive parkland next to Ruggles Station will receive additional planting materials and a new tot lot or play area with entry gazebo and security fencing. This play area will primarily accommodate outdoor activities for the proposed day care function in the adjacent building. Other landscape features such as locational or directional markers and graphics, lighting, pavement markings, designated pedestrian crosswalks and trash receptacles will be provided as needed.

Special Users

Day Care

The play area proposed for this alternative accommodates the open space needs of day care facilities located in the office buildings at Ruggles Center. Although the playground will be for use exclusively by these facilities, it will be an integral part of the Southwest Corridor Park. It will be visible from various points along adjacent sidewalks. Extensive tree plantings along Ruggles Street and the side adjacent to the rest of the park will help screen or shield the play area to the extent possible from winds as well as noise and exhaust from cars and buses on Ruggles Street. Every effort will be made to comply with any city or state criteria governing these issues.

This play area will be circular in shape and approximately 100 feet in diameter and will be depressed an average of three feet below existing grade. An entry gazebo is placed adjacent to the SWCP and serves also as a park element. Inside the play area, tiers of steps which

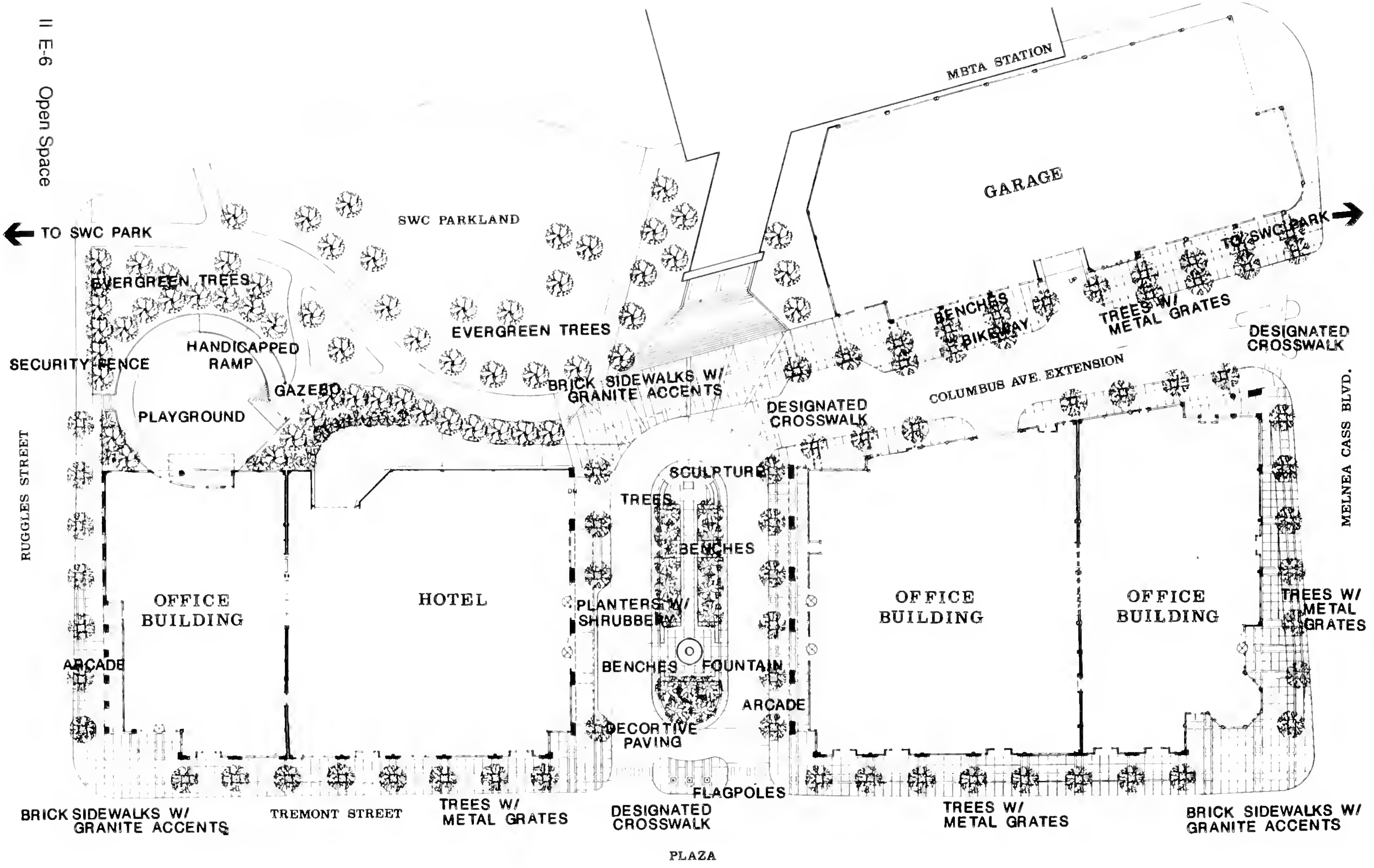


Figure II E-3: Landscape Materials and Elements for Master Plan Design

go down to ground level will also act as seating for various playground functions. A handicapped ramp will facilitate movement from the parkland to the play area. Adding to the security and surveillance of the playground, an open, appropriately sized security fence will be constructed around most of its perimeter.

Bicyclists

The Southwest Corridor Park currently allows bicyclists to travel its entire length alongside pedestrians. This is made possible through a combined, paved bikeway/sidewalk that is an integral part of the landscape features of the park itself. Certain locations are clearly marked with information kiosks that identify the designated bicycle route up and down the Corridor. Although the bikeway/sidewalk varies in width along the length of the Corridor, it opens up to an expansive, thirty-foot wide paved area at the Columbus Avenue/ Melnea Cass Boulevard intersection and passes through the project site up to the Ruggles Station entry. The Master Plan Design proposes to maintain the continuity of this thirty-foot wide area and enhance it with appropriate landscape features. In order to minimize potential conflicts between pedestrians and cyclists, the paved area may be designated for pedestrian use on the portion closest to the garage building, while the portion next to the street would be for cyclists. Only one curb cut for vehicular access through the project site is proposed and appropriate signage will be installed to slow automobile traffic crossing the bikeway at that point.

Landscaping for Mitigative Purposes

Urban Coherence, Safety, and Access

In many respects, the Master Plan open space design is a mitigation measure itself. It responds to initial design objectives and comments offered by those who have reviewed the project. Overall, the landscape plan contributes to the coherence of the Ruggles Center development. It is the 'connecting tissue' that links the office and hotel buildings to the surrounding urban area and the Southwest Corridor Park. Special care has been given to address the needs of a diverse group of users: pedestrians, office workers, shoppers, bicyclists and commuters. The plan defines areas for sitting, safe walking and cycling and enables good access to Ruggles Street Station, the Plaza, and the neighborhood.

Noise and Wind

Additional landscape elements will be deployed as one measure of mitigating adverse localized wind or noise situations around Ruggles Center. These elements, including various tree and shrub plantings, high planters and grade changes, will be strategically lo-

cated to improve conditions for various pedestrian activities on the site. In the case of anticipated unpleasant wind conditions, extensive evergreen trees and shrubbery in high planters will serve to decrease ground level winds or divert them to other areas. In order to ameliorate potential noisy areas to the extent possible, tree groupings will be planted to help filter and mask noise levels from nearby bus and auto traffic.

A full discussion of the specific landscaping elements used as wind screens can be found in Chapter II, Section D.

For reasons similar to the above, the same landscape features (dense tree plantings) will be incorporated to help screen the proposed play area from the MBTA station. This play area will be constructed approximately three feet below the existing grade of the adjacent SWCP to further shield it from unpleasant wind and noise conditions.

F. Construction Impacts

Introduction

This section of the FEIR investigates construction-related impacts stemming from: materials movement; staging areas; noise and vibration; construction of foundations; dust, debris and emissions. Also considered are the cumulative effects of other construction taking place in the area at the same time.

Since the DEIR, modifications to the foundation design have reduced initial concerns about noise and vibration and the amount of excavation required. This section presents an up-to-date discussion of construction methods and mitigation measures.

Construction Schedule

Ruggles Center is a phased development, beginning in 1990 and extending over a six year period. Phase 1 includes construction of Building 2, the above ground parking garage (Building 5), and the central plaza. In the next phase, Building 1 will be built, followed by Buildings 3 and 4. The actual construction schedule will be determined by the final refinement of the building program, market conditions, and the developer's ability to find commercial tenants.

A phased program of development will enhance the options for on-site staging of construction. The Ruggles Center site is large enough to contain most staging and construction activities, particularly for earlier buildings. During later phases of development, "just-in-time" delivery of construction materials can confine construction activity to the site and limit interruptions of activity in the surrounding area.

Foundations

The type of foundation used and site conditions will determine many of the impacts on groundwater and the extent of noise and vibrations experienced in the area. The Master Plan Design will use foundation structures and construction practices to mitigate these impacts.

The proposed foundations for Buildings 1 and 2 will be a structural mat on densified soil at grade. By balancing cuts and fills required for those two buildings and constructing at ground level, the quantity of excavated material to be removed from the site will equal approximately 1,000 cubic yards per building. This will minimize truck traffic. At grade construction also will eliminate the need for a dewatering system when foundations are installed. Soil densification

will be accomplished by utilizing a grid of compacted sand elements approximately ten feet deep. The probable duration for installation of compacted sand elements will be 50 days per building.

In utilizing this method, the area of influence for underground vibration is significantly less than if a deep pile foundation were installed. Ground grade construction eliminates the problem of lowering groundwater in the surrounding area.

Building 5 is an above ground parking structure. Because the MBTA has reserved the right to build a new transit tunnel under this subparcel and because a thick layer of marine clay underlies this portion of the site, the foundation of the garage will require deep piles (180 feet) to support the building above the tunnel. The piles will be either high capacity steel pipes filled with concrete or precast concrete piles. To minimize vibration at Ruggles Street Station, the preaugering of piles could be used.

Under Buildings 3 and 4, the Master Plan Design calls for a below grade parking garage. The foundation system for these buildings may be a deep mat foundation or deep piles. The earth retention system would be sheet piling vibrated into place to produce a water tight cofferdam. The use of a vibratory hammer should reduce airborne noise. Once the cofferdam is in place, ground will be lowered within the contained site to allow for the installation of an underslab pressure relief system which would maintain lowered groundwater within the site. The sheeting would be left in place to minimize water infiltration and be cut off five feet below grade.

Noise and Vibration

Noise

Noise will be generated by construction activity, building equipment use, and vehicles traveling to and from the site. The latter two sources will have an insignificant effect on the noise environment in the vicinity of the site. However, construction activities are likely to generate noise levels above background conditions.

The City of Boston regulates construction noise by limiting the hours of construction from 7:00A to 6:00P, Monday-Friday. Additional hours of construction activity require a variance. Equipment noise (except impact device noise) is limited to no more than 80 decibels at 100 feet from the source of the noise.

Construction activities can be separated into different stages, each of which generates specific noise characteristics. These stages are clearing, demolition, or site preparation; excavation; foundation construction; frame erection; and finishing/clean-up. Noises associated with these activities were determined with the use of an Environmental Protection Agency noise model (Bolt, Beranek and Newman, 1971).

The various stages of construction will have different noise characteristics as presented in Table II F-1. The highest noise levels occur during ground clearing, excavation, and finishing, while the other construction phases generally are quieter.

For the first phase of development, at grade construction will significantly reduce noise and vibrations generally associated with deep piles. The use of vibratory hammers to install steel sheet piling for Buildings 3 and 4 will reduce the airborne noise.

Vibration

The primary source of construction-related subsurface vibrations will occur during installation of foundation structures. For Buildings 1 and 2, a grid of compacted sand elements, approximately 10 feet deep, will be driven to densify the soil in preparation for a structural concrete mat foundation at ground grade. The area of influence for these piles could be up to 100 feet. Vibrations would be noticeable at certain utility corridors and possibly at Ruggles Street Station. However, because the compaction depth is shallow, the resulting vibrations for each element will be of short duration and are not expected to adversely affect structures or utilities within the area of influence.

For Buildings 3 and 4, the underground garage will necessitate perimeter support of adjacent ground, probably using steel sheet piling. In addition, structural concrete piles also may be used to support the building. Some vibration and ground heave or settlement might be expected. However, to mitigate these impacts, preaugering would be used for about two thirds of the pile length (80 to 100 feet). For Building 5, foundation piles will also be pre-drilled.

To minimize potential impacts of vibration on sensitive research equipment at Northeastern University, field tests will be conducted. These will be evaluated in conjunction with vibration performance requirements for research equipment located within the area of influence.

Table II F-1 Typical Ranges of Noise Levels at Construction Sites

Construction Phase	Equipment	Average dB(A)*
Ground Clearing	Truck, Scraper	84
Excavation	Front Loader, Backhoe, Tractors, Trucks	89
Foundations	Concrete Mixer, Compressors, Pile Driver	78
Erection	Cranes, Compressors	85
Finishing	Compressors	89

Notes: Table assumes a 70 dB(A) ambient noise level, typical of urban areas. The term dBA refers to A-weighted decibels which best represents frequencies which are most annoying to the human ear.

Source: US EPA, Noise from Construction Equipment and Operations, Building Equipment and Home Applications.

Dust, Debris, and Emissions

During the period of construction of the proposed development, some short term adverse impacts on air quality will occur. An increase in airborne particulate matter will occur in the form of fugitive dust from ground excavation, from mounds of stored earth and aggregate, from concrete construction, and from carpentry work and similar activities. The extent of dispersion of this dust relates directly to wind conditions, construction activities, transfer methods, particulate dimensions, and mitigation measures.

The Master Plan Design has reduced greatly the amount of site excavation required. By itself, ground grade construction will limit the amount of dust emitted during excavation and foundation work. Nevertheless, ground preparation, earth storage, and building materials are major sources of particulate matter. The degree of emissions will depend on the properties of emitting surfaces (e.g., soil silt content, moisture content and volume of spoils), meteorological variables, and the construction practices employed.

Exposed earth removed in the process of excavation as well as gravel/sand/concrete dumped on the site are potential dust emitters during mechanical disturbances and transfer operations, as well as during high winds. In either case, the bulk of the dust is emitted shortly after the initial loading of a freshly processed aggregate because it is during this period that the fine particles are most easily dislodged. Subsequent rainfall moistens the interior of the mounds and the moisture is released very slowly. Thus, the emissions from storage mounds depend primarily on the regional precipitation/evaporation (PE) index. The PE index is a measure of the precipitation to evaporation ratio and, in the contiguous United States, ranges from a low of 10 (highly conducive for dust particles) in the arid southwest to approximately 170 (not conducive for dust particles) in the upper northeast. In the Boston area, the PE index is 132, well above the average for the U.S. as a whole. This would indicate the potential for only a moderate amount of fugitive dust generation from construction operations if standard construction dust mitigation measures are enforced.

Debris from construction is another form of pollution that will be generated on the site. This waste material would include wood, plastic sheeting, wrapping materials, and trash resulting from construction operations. The developer will remove such waste/debris from the site frequently to assure that it does not create a waste problem.

Traffic Management

The chief transportation impacts that are of concern during the construction period are traffic impacts on streets leading to and around the site, worker parking, unloading and placement of construction materials and equipment, and site fencing and maintenance to protect pedestrians. Through licensing and approval procedures, the City of Boston requires advance planning and coordination to mitigate traffic impacts during construction.

Prior to issuing a building permit, the City of Boston will require that the developer submit a detailed Traffic Maintenance Plan. This plan is prepared in conjunction with the general contractor and is subject to approval by the Boston Transportation Department. Some limitations exist in detailing a Traffic Maintenance Plan months in advance of construction itself. However, it is possible to state a number of principles which would govern the construction process and which would minimize adverse impacts to the area.

To plan for the least disruptive construction period, the phasing of construction work should be coordinated with other proposed construction activities in the area. The use of on-site locations for construction staging will be necessary to minimize disturbances to the other construction activities occurring in the proximity of the project.

Trucks transporting material and equipment to and from the site should be routed on major highways and arterial streets to the greatest extent possible. For all phases of construction, the major truck route would be the Central Artery to Melnea Cass Boulevard with a left turn at Columbus Avenue onto the Ruggles Center site. Depending on the phase of construction, the trucks would exit the site at either Tremont Street or Melnea Cass Boulevard.

Deliveries will be scheduled and access times controlled so that peak hour disruptions would be avoided. Such peak hour congestion is as detrimental to the construction process as it is to general traffic. At and near the site, truck maneuvering will be supervised by flagmen or police as necessary, and time at the site will be kept at a minimum. Controls governing the spilling of materials from trucks must be observed, including avoiding washing out concrete trucks into the street.

Construction workers may be able to use available on-site areas

for parking during the early stages of construction. In addition to on-site spaces, which will be increasingly limited, construction workers will be encouraged to use public transportation.

Other Construction Projects

A considerable amount of both public and private investment is underway or anticipated in the general vicinity of Ruggles Center. Between now and 1996 approximately 806,000 square feet of space and 1,223 units of housing are scheduled to come on line in addition to Ruggles Center.

Several developments planned in the immediate vicinity are likely to have construction phases that will overlap with construction activities at Ruggles Center. These projects, the location of which are shown on Figure II A-13, include the Phase I development of BRA Parcel P-3 for nearly 660,000 sq. ft. of retail and office space, the construction of 200 housing units on MBTA Parcel 22 and additional housing on BRA Parcels P-9, P-10, and 16a, the construction of a new university library facility and the proposed construction of a recreational facility/schoolboy track by Northeastern University, and the renovation of a large section of the Mission Hill Extension Housing Project.

Potential cumulative construction related impacts (traffic, noise, and air quality) may occur. Should schedules overlap to a large degree, truck traffic would increase along Ruggles Street, Tremont Street, and Melnea Cass Boulevard, with an increased level of concern for noise and air quality. In addition, construction staging areas could become an issue, depending on the ability of each development to provide adequate on-site storage.

Mitigation Measures

Materials Movement Staging

Coordination of construction schedules, truck routing, and staging areas for all projects in the area should be undertaken once preliminary construction schedules have been established. This activity will be coordinated by the City of Boston through its traffic maintenance review process. The Boston Transportation Department requires that a Traffic Maintenance Plan be approved prior to the issuance of a building permit by the Inspectional Services Department.

Noise

A legal limit for construction of 80 decibels at 100 feet from the noise source is administered by the Boston Air Pollution Control

Commission. Most of the noise during construction will be derived from internal combustion engines. Equipment used on the site, with the exception of pile drivers, will operate within this legal limit. The use of compacted sand elements for soil densification will significantly reduce the level of noise for construction of Buildings 1 and 2. The use of a vibratory hammer will reduce airborne noise when sheet piling is vibrated in place.

Vibration

When driving deep piles, the primary method to mitigate the potential impact of subsurface transmission is to incorporate the preaugering installation method. Preaugering for long end-bearing precast concrete piles would be to about two thirds of the pile length. The remaining length of the pile would be driven into place. Another method of mitigation is drilled-in piles. With this method, piles are actually drilled into bedrock. Either of these methods may be used if the impacts of pile driving are determined to be unacceptably high.

To assess the area influence subject to vibration during pile installation, a ground control survey of adjacent streets and structures will be conducted prior to construction of each building.

Groundwater

The project proponent has selected foundation structures which minimize lowering the depth of groundwater. Ground grade construction for Buildings 1, 2 and 5 will leave the depth of groundwater virtually unchanged. The use of interlocking steel sheet piling to support the sides of deep excavations is also a mitigation measure for Buildings 3 and 4 where underground garages are planned. Sheet piling will be relatively to very impermeable to groundwater seepage. This will significantly limit off-site groundwater lowering.

The need for groundwater recharging can only be assessed if the depth of groundwater lowering below the tops of wood piles is known. However, there are many instances where groundwater lowering for construction has occurred for up to one year without causing appreciable deterioration to wood piles. At this time, no buildings in the surrounding area are known to have wood pilings. Therefore, the issue of possible adverse impact of construction-lowered groundwater levels on wood piles is thought to be moot.

Nevertheless, it is agreed that to monitor groundwater levels, the following mitigative measures are recommended:

- Monitor the groundwater levels during construction at sites with deep excavation. Observation wells should be installed around the site perimeter at 100 feet spacing. Additional observation wells should be installed adjacent to wood pile-supported buildings, if any, and across the street from the excavation site. Groundwater levels should be measured in the observations wells at least weekly, more frequently if there is significant groundwater lowering (below elevation -1.0 NGVD) is found.

- Permanent observations wells should be installed around the perimeter of permanent, below groundwater level structures, such as the deep parking garages proposed for Buildings 3 and 4. A monitoring program should be instituted to measure groundwater levels throughout the life of the structure if portions of the structure basement are below groundwater level.

Groundwater withdrawn from the site during construction will be pumped to a siltation settling tank/basin to remove fine material, prior to discharge to the existing storm drain system. The existing storm drain system contains adequate reserve capacity to receive the quantity of water expected to be generated during construction (BWSC, 1986). The expected duration of the dewatering operation would be approximately one year. If a dewatering program is designed to maintain ambient groundwater levels, no adverse effects should be expected during or after construction.

No permanent discharge of groundwater to sewers and storm drains is expected. Water from the pressure relief system would be recharged in surficial soil strata.

Dust, Debris, and Emissions

Mitigation measures which may be employed to reduce fugitive dust emissions from construction activities include minimal storage of excavated soil and aggregate on the site, wetting of earth mounds on a scheduled basis, minimizing disturbance of loose materials, and storing materials away from pedestrian walkways. Containment of other construction materials and miscellaneous trash will be controlled by proper supervision. As required by the Massachusetts Contingency Plan, the project proponent will have in place at the time of construction, a Remedial Response Plan to handle contaminated soil or other hazardous substances. (See Chapter II, Section G, Hazardous Substances.) Early removal of waste materials from the site will mitigate much of the potential problem of emissions.

G. Hazardous Substances

Introduction

Since the DEIR, investigations of the Ruggles Center site have c ontinued. This section reviews the results of recent site investigations and provides an overview of the Massachusetts Contingency Plan (MCP), which regulates procedures governing release of oil or hazardous materials to the surrounding environment.

Prior Investigations

Ruggles Center was formerly the site of numerous businesses identified in preliminary studies as potential sources of contamination. These included gasoline service stations, auto body shops, laundries, a coal yard, a chemical storage company and other light manufacturing or warehousing businesses.

In preparation for development, two separate investigations in accordance with Massachusetts General Law (MGL), Chapter 21E, were undertaken for the BRA to determine the potential for oil or hazardous material contamination. The first, a report by WCH Industries (1986), did not reflect any subsurface testing. The report indicated the presence of oil contamination based on site history and usage. The second, prepared by Rizzo Associates (1987) included sampling and testing of subsurface soils. The Rizzo Study located one underground storage tank out of several suspected to be on the site. Composite sample results indicated that the "concentrations of contaminants detected are not extraordinarily high for urban fill materials." The report recommended additional surveys to locate the other buried tanks.

During a subsurface boring program conducted for the proposed foundation design in the summer of 1988, drillers observed that some of the soil and groundwater appeared contaminated with petroleum. Although the two prior 21E reports were waiting for Department of Environmental Protection (DEP) approval, a third oil and hazardous material investigation was conducted for the developer by Haley and Aldrich. The report indicated the presence of petroleum contamination and discussed the significant cost impacts associated with removal of the contaminated material. The report recommended that due to the large variety of business and manufacturing activities which took place long ago, extensive study of the site be conducted per MGL 21E regulations and that regulatory interaction take place.

Massachusetts Contingency Plan

In October, 1988, MGL 21E was supplemented by the MCP, an overview of which is stated below.

Under the MCP, four phases of investigation are required; namely:

I. Preliminary Assessment and Limited Site Investigation;
II. Comprehensive Site Assessment (including risk assess ment);
III. Development of Remedial Response Alternatives; and
IV Implementation of the Approved Remedial Response Alternative.

The project is currently in the final stages of Phase II. Haley and Aldrich submitted a final Draft Phase II report on August 4, 1989. Pending review comments, the final report will be completed and the project will advance to further investigations under Phase IIA (further investigations). Phases III and IV will follow and be completed prior to construction.

Site Investigation Results

Phase I and II Oil and Hazardous Material Site Evaluations have been conducted at Ruggles Center following the guidance of the Massachusetts Contingency Plan. Chemical test data from the Phase II evaluation indicate that some petroleum contamination is present in certain areas in the soils and groundwater beneath the site.

Some site soils have been contaminated primarily by petroleum hydrocarbons including gasoline, kerosene, fuel oil and lubricating oils as well as low levels of pesticides and metals distributed randomly throughout the site soil. The contamination is likely to have resulted from petroleum storage on site, fill materials brought on site during several stages of filling or from former on-site commercial and light manufacturing operations. Much of what was found at the site can be characterized as urban fill typical of downtown Boston.

In most instances, groundwater at the site was found to contain low levels of petroleum hydrocarbons, associated volatile organic compounds, metal and pesticides. Groundwater, in most instances, however, meets drinking water guidelines or standards available for selected compounds.

Investigations located three underground storage tanks. A fourth storage tank is suspected. Phase-separated petroleum product was found near the suspected tank location as well as in a test pit where kerosene was also identified.

Risk Assessment Results

A risk assessment was conducted by Meta Systems and Menzie and Associates, Inc. in May, 1989 to evaluate the risk of harm to human health, safety, public welfare and the environment from contamination at the site. The assessment evaluated several different target receptors using various exposure points and migration pathways. All of the scenarios involved at grade construction schemes.

The risk assessment found that risks to human health or the environment associated with the site in its present condition, during and after construction, do not exceed DEP's benchmarks for acceptable risks.

The report did recommend that dust control measures be implemented during construction and that risks to children be minimized by capping the soil or removing soil and filling play areas with clean material.

Mitigation/ Enhancement Measures

The Phase II investigation found that excavation and exposure of the contaminated soil to the air would, in some cases, create more problems than it resolved. It recommended that construction activity be modified to limit soil excavation, where possible, and that an at-grade construction scheme be used to allow for on-site re-use of excavated materials.

Phase III of the MCP requires evaluation of a variety of remedial action alternatives. During this study, remedial response alternatives will be considered such as: on- and off- site treatment, on-site containment and monitoring, off-site disposal, and elimination or minimization of exposure. Following development of this plan, an Implementation Plan will be completed for use as a guide during site development.

Mitigation

Results of Phase I and II investigations already suggest several important mitigation measures. To minimize soil excavation, the Master Plan Design has been altered to use at-grade construction schemes. At grade construction for Buildings 1, 2 and 5 will reduce the

number of underground parking spaces. For Buildings 3 and 4, where underground parking is planned, contaminated soil will be removed where necessary in compliance with DEP regulations.

Other mitigation measures include the following:

a. Underground tanks will be located and removed. Petro leum contaminated soil surrounding the tanks will be removed and disposed of in accordance with Federal, State and local requirements.

b. Phase-separated petroleum products identified at the site will be further evaluated and mitigated in accordance with the findings of the evaluation.

c. Risks to children will be minimized by capping or removing soil from play areas and filling with clean material.

d. Dust control measures will be adopted during construction activities to reduce levels of risk associated with concentrated metals in the soil.

e. Construction supervisors and workers will be briefed on known site conditions and the potential for discovery of buried tanks, utility piping and wiring, and other objects which may be unearthed during excavation of the site.

f. A management plan will set procedures to limit and avoid spillage and emissions, take corrective action should they occur and carry out remediation in accordance with DEP regulations.

g. Construction activity will be monitored to identify heavily contaminated soils which may require special handling.

h. Construction supervisors and workers will be advised to use caution in handling fuels and oils on the site to avoid spillage and contamination of the soil. No smoking signs and other precautionary notices will be prominently posted in accordance with the fuel storage and use plan.

i. On-site re-use of excavated soil with low levels of contamination will be utilized, where feasible.

j. Once construction is completed, chemicals and other substances used by tenants will be controlled by the establishment of prevention plans and procedures to deal with unplanned releases.

Implementation Plan

Once the Remedial Response Plan is developed, prompt action will be taken to obtain all federal, state and local permits, licenses, and agreements necessary to implement the Plan. In addition, a single source document, the Implementation Plan, will be prepared to guide construction activities. Included in the Implementation Plan are:

- list of contacts;
- site map;
- final design, consisting of complete plans and specifica tions which shall include: schedule for implementation; complete plans and specifications; health and safety plan; environmental monitoring plan; contingency plan;
- construction plan, including all of the above, in final form;
- operations and maintenance plan, including quality assurance and quality control.

The Remedial Response Plan and Implementation Plan, once in place, should provide adequate prevention and control measures for the site so that there will be no long-term adverse impacts from the proposed development.

Secretarial Decisions

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APPENDIX A
COMMONWEALTH OF MASSACHUSETTS
EXECUTIVE OFFICE OF ENVIRONMENTAL AFFAIRS

ENVIRONMENTAL NOTIFICATION FORM

Do not write in this space

I. SUMMARY

A. Project Identification

1. **Project Name** Parcel 18

2. **Project Proponent** Boston Redevelopment Authority
   Address Boston City Hall
   Boston, MA 02201

B. Project Description: (City/Town(s) Boston (Roxbury)

1. **Location within city/town or street address** Melnea Cass Blvd./Tremont St./Ruggles St.

2. **Est. Commencement Date:** Spring 1988 **Est. Completion Date:** Fall 1993
   Approx. Cost $ 245,000,000 **Current Status of Project Design:** 5 **% Complete**

C. Narrative Summary of Project

Describe project and give a description of the general project boundaries and the present use of the project area. (If necessary, use back of this page to complete summary).

The Parcel 18 development at Ruggles and Tremont Streets in Roxbury is envisioned as a dynamic mixed-use urban center focusing on the Ruggles Station concourse of the relocated Orange Line rapid transit line. This complex, to be developed in several stages, will include a mix of office, retail, housing, and community facilities which would be accommodated in a series of mid-rise and high-rise structures with ample parkland, subsurface parking, and numerous street amenities. The goal of the project is to transform a vacant parcel of land created by the Southwest Corridor transit system into a community resource that can meet the need of the adjacent neighborhoods and institutions.

The development will potentially involve the construction of two office buildings supporting ground floor retail activity flanking a pedestrian walkway leading to the Ruggles Station concourse. Three alternative massings currently are under consideration as the range of commercial/office development options for the site: Height options under consideration for these two buildings range from 125 feet to 225 feet. In no event will the total gross square footage for the commercial/office development exceed 860,000 square feet for both buildings.

Also included will be parking to accommodate 500 to 1,200 cars. The development may also include 100,000 sq.ft. of retail space in another building adjacent to Ruggles Station, as well as a 150,000 sq.ft. residential mid-rise to include a significant market-rate component as well as housing opportunities for individuals and families of low- and moderate-income, and a proposed community cultural center.

(continued on back)

Copies of this may be obtained from:
Name: Richard B. Mertens Firm/Agency: Boston Redevelopment Authority
Address: Boston City Hall, Boston, MA 02201 Phone No. 722-4300, X323

1979

THIS IS AN IMPORTANT NOTICE. COMMENT PERIOD IS LIMITED.
For Information, call (617) 727-5830

Use This Page to Complete Narrative, if necessary.

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This project is one which is categorically included and therefore automatically requires preparation of an Environmental Impact Report : YES X NO ____

D. Scoping (Complete Sections ~~II and III~~ first, before completing this section.)

1. Check those areas which would be important to examine in the event that an EIR is required for this project. This information is important so that significant areas of concern can be identified as early as possible, in order to expedite analysis and review.

	Construction Impacts	Long Term Impacts		Construction Impacts	Long Term Impacts
Open Space & Recreation		X	Mineral Resources		
Historical			Energy Use	X	X
Archaeological			Water Supply & Use		X
Fisheries & Wildlife			Water Pollution		
Vegetation, Trees			Air Pollution	X	X
Other Biological Systems			Noise	X	X
Inland Wetlands			Traffic	X	X
Coastal Wetlands or Beaches			Solid Waste	X	X
Flood Hazard Areas			Aesthetics		X
Chemicals, Hazardous Substances, High Risk Operations	X		Wind and Shadow		X
			Growth Impacts		X
Geologically Unstable Areas	X	X	Community/Housing and the Built Environment		X
Agricultural Land					
Other (Specify)					

2. List the alternatives which you would consider to be feasible in the event an EIR is required.

1. Alternative Project Massings and Scales
2. Alternative Project Phasings

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E. Has this project been filed with EOEA before? Yes ______ No X
If Yes, EOEA No. __________ EOEA Action? __________

F. Does this project fall under the jurisdiction of NEPA? Yes ______ No X
If Yes, which Federal Agency? __________ NEPA Status? __________

G. List the State or Federal agencies from which permits will be sought:

Agency Name	Type of Permit
Massachusetts Division of Water Pollution Control (DEQE)	Sewer Connection Permit
Metropolitan District Commission	Industrial Use Permit
Department of Public Works	Curb Cut Permit
FAA	Section 77 Federal Aviation Regulations Revi
BRA/MBTA	Land Disposition Agreements

H. Will an Order of Conditions be required under the provisions of the Wetlands Protection Act (Chap. 131, Section 40)?
Yes ______ No X

DEQE File No., if applicable: __________

I. List the agencies from which the proponent will seek financial assistance for this project:

Agency Name	Funding Amount
Executive Office of Communities and Development	SHARP or Massachusetts Housing Partnership Funds
	Community Development Action Grant
Executive Office of Transportation and Construction	State Parking Facilities Funds
U.S. Dept. of Housing and Urban Development	Urban Development Action Grant

II. PROJECT DESCRIPTION

A. Include an original 8½ x 11 inch or larger section of the most recent U.S.G.S. 1:24,000 scale topographic map with the project area location and boundaries clearly shown. Include multiple maps if necessary for large projects. Include other maps, diagrams or aerial photos if the project cannot be clearly shown at U.S.G.S. scale. If available, attach a plan sketch of the proposed project.

B. State total area of project: 5.6 acres
Estimate the number of acres (to the nearest 1/10 acre) directly affected that are currently:

1. Developed .... ____ acres
2. Open Space/Woodlands/Recreation ____ acres
3. Wetlands .... ____ acres
4. Floodplain .... ____ acres
5. Coastal Area .... ____ acres
6. Productive Resources
   - Agriculture .... ____ acres
   - Forestry .... ____ acres
   - Mineral Products .... ____ acres
7. Vacant Urban Land 5.6 acres

C. Provide the following dimensions, if applicable:
Length in miles NA Number of Housing Units 150-200 Number of Stories 2 - 17

	Existing	Immediate Increase Due to Project
Number of Parking Spaces	310	190-890
Vehicle Trips to Project Site	465	2,980-4,555
Estimated Vehicle Trips past project site	31,000	3,900 - 6,700

D. If the proposed project will require any permit for access to local or state highways, please attach a sketch showing the location of the proposed driveway(s) in relation to the highway and to the general development plan; identifying all local and state highways abutting the development ; and indicating the number of lanes, pavement width, median strips and adjacent driveways on each abutting highway. and indicating the distance to the nearest intersection.

See attached site plan

SOUTHWEST CORRIDOR PARCEL 18

SCALE 1:25 000

1 0 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 .5 0 1 KILOMETER

CONTOUR INTERVAL 10 FEET

BOSTON SOUTH, MA

N4215—W7100/7.5

1970

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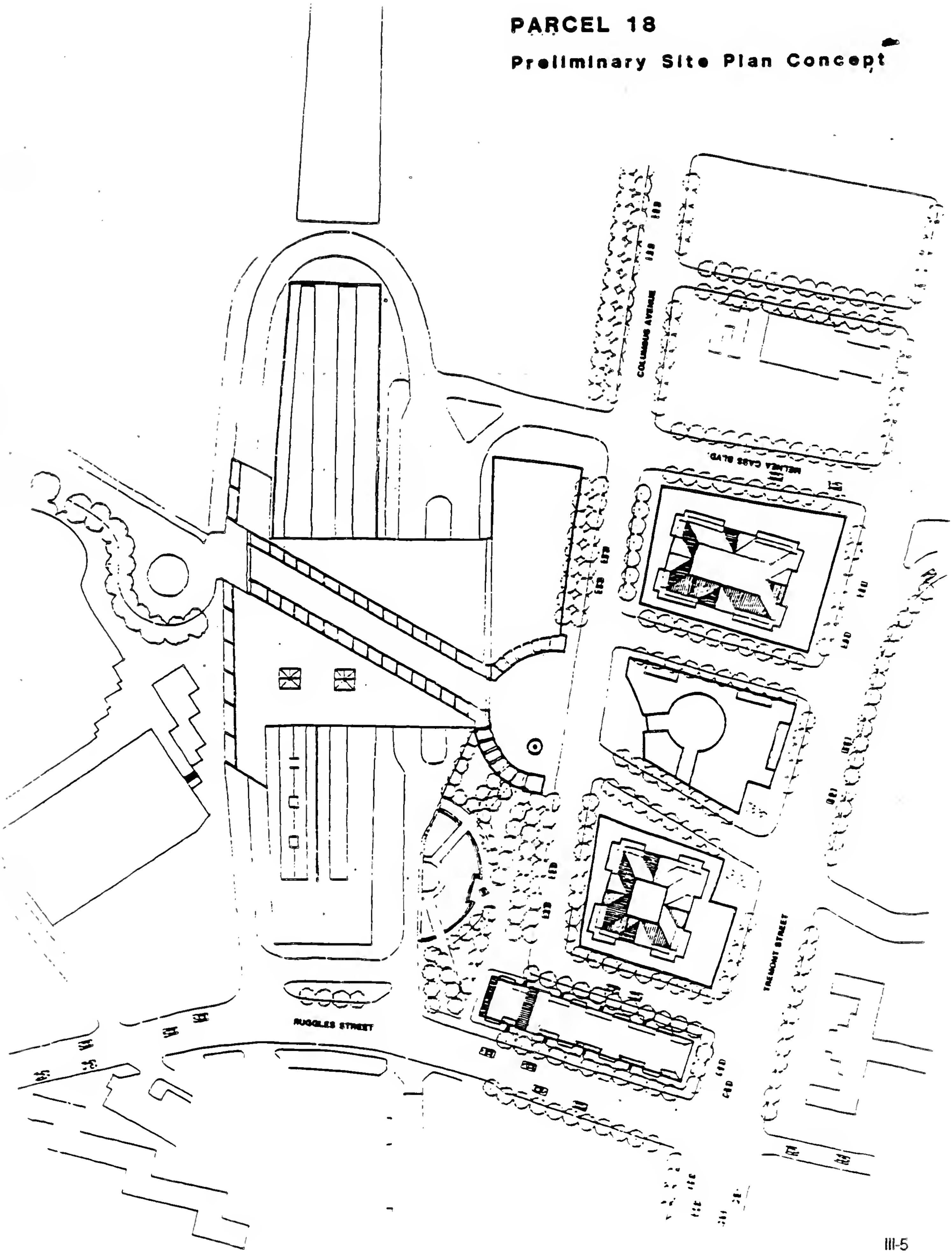
AMS 6768 I SE—SERIES V81

PARCEL 18

Preliminary Site Plan Concept



ASSESSMENT OF POTENTIAL ADVERSE ENVIRONMENTAL IMPACTS

Instructions: Consider direct and indirect adverse impacts, including those arising from general construction and operations. For every answer explain why significant adverse impact is considered likely or unlikely to result.

Also, state the *source* of information or other basis for the answers supplied. If the source of the information, in part or in full, is not listed in the ENF, the preparing officer will be assumed to be the source of the information. Such environmental information should be acquired at least in part by field inspection.

A. Open Space and Recreation

1. Might the project affect the condition, use or access to any open space and/or recreation area?
Yes X No ___

Explanation and Source:

No recreation or open space uses currently exist on-site.

A variety of open spaces and pedestrian walkways will be provided as part of the development project. In addition, a landscaped park area may be constructed off Ruggles Street adjacent to Ruggles Station as a continuation of a proposed linear park to run above and along side the Orange Line transit corridor. These open spaces would be accessible to and available to project residents and occupants as well as to adjacent neighborhoods. It is expected that the project will itself become an active public area, incorporating both recreational facilities and some open space for the enjoyment of the Roxbury community.

B. Historic Resources

1. Might any site or structure of historic significance be affected by the project? Yes ___ No X

Explanation and Source:

The project site is vacant land. There are no historical properties in the immediate vicinity of the project site.

Boston Landmarks Commission.

2. Might any archaeological site be affected by the project? Yes X No ___

Explanation and Source:

According to the City Archaeologist, there is a possibility that the project site could contain archaeological resources. Therefore, an archaeological survey will be required prior to construction of the project.

C. Ecological Effects

1. Might the project significantly affect fisheries or wildlife, especially any rare or endangered species?
Yes ___ No X

Explanation and Source:

The project site is an urban parcel used for parking and construction staging and does not contain any rare or endangered species of wildlife or any fisheries.

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Massachusetts National Heritage Program

2. Might the project significantly affect vegetation, especially any rare or endangered species of plant?
Yes ______ No __X__
(Estimate approximate number of mature trees to be removed: ____0____)

Explanation and Source:

The project site is an urban parcel used for parking and construction staging and is devoid of any vegetation except for scattered patches of grasses and weed species.

3. Might the project alter or affect flood hazard areas, inland or coastal wetlands (e.g., estuaries, marshes, sand dunes and beaches, ponds, streams, rivers, fish runs, or shellfish beds)? Yes ______ No __X__

Explanation and Source:

The project site is not located within a flood hazard area nor is it adjacent to any inland or coastal wetland.

Federal Emergency Management Agency Flood Insurance Rate Map (Panel #2502860010C, April 1982)

4. Might the project affect shoreline erosion or accretion at the project site, downstream or in nearby coastal areas? Yes ______ No __X__

Explanation and Source:

The project site is an inland site and is not located near any shoreline or coastal area.

5. Might the project involve other geologically unstable areas? Yes __X__ No ______

Explanation and Source:

Marine clay deposits underlie the entire site and are subject to long-term settlement problems and differential movements. The subsurface soil profile indicates in certain zones of the site deep end-bearing piles would be required to support any high-rise structures.

Haley & Aldrich, Inc. Settlement Studies, Parcel 18 area

D. Hazardous Substances

1. Might the project involve the use, transportation, storage, release, or disposal of potentially hazardous substances?
Yes __X__ No ______

Explanation and Source:

The parking garage will entail the storage of automobiles containing gasoline. No other potentially hazardous substances are expected to be used or stored on-site. The site may contain unknown buried hazardous wastes, the presence of which will be determined by a 21E survey.

E. Resource Conservation and Use

1. Might the project affect or eliminate land suitable for agricultural or forestry production?
Yes ______ No __X__
(Describe any present agricultural land use and farm units affected.)

Explanation and Source:

The project site is located in the midst of a developed urban area and does not support any agricultural or forestry production.

2. Might the project directly affect the potential use or extraction of mineral or energy resources (e.g., oil, coal, sand & gravel, ores)? Yes ______ No __X__

Explanation and Source:

No mining activities occur in the vicinity of the project site.

3. Might the operation of the project result in any increased consumption of energy? Yes __X__ No ______

Explanation and Source:
(If applicable, describe plans for conserving energy resources.)

Since the project site presently is vacant land, the proposed project will result in increased energy consumption. The buildings will incorporate energy-efficient design standards and will meet the requirements of the Massachusetts Energy Code. Energy also will be consumed for the construction of the project.

F. Water Quality and Quantity

1. Might the project result in significant changes in drainage patterns? Yes __X__ No ______

Explanation and Source:

Development of the project site with buildings and paved surfaces will substantially increase the amount of impervious surfaces, which will result in increased runoff. All site runoff will be directed into the City's storm drainage system.

2. Might the project result in the introduction of pollutants into any of the following:
(a) Marine Waters .... Yes ______ No __X__
(b) Surface Fresh Water Body .... Yes ______ No __X__
(c) Ground Water .... Yes ______ No __X__

Explain types and quantities of pollutants.

The project will result in no direct discharge into marine or fresh water bodies. Sanitary sewage will be conveyed to MDC treatment facilities and ultimately discharged into Boston Harbor; storm runoff will be conveyed via local sewers to the Stony Brook Conduit and thence to the Back Bay Fens.

3. Will the project generate sanitary sewage? Yes X No ____
If Yes. Quantity: * gallons per day
Disposal by: (a) Onsite septic systems .... Yes ____ No X
(b) Public sewerage systems .... Yes X No ____
(c) Other means (describe) ____

*70,750 - 105,000 gallons, depending on development option

Title 5, Massachusetts Environmental Code (Sewage Flow Estimates)

4. Might the project result in an increase in paved or impervious surface over an aquifer recognized as an important present or future source of water supply? Yes ____ No X

Explanation and Source:

The project is not located over an aquifer recognized as a present or future source of water supply.

5. Is the project in the watershed of any surface water body used as a drinking water supply?
Yes ____ No X
Are there any public or private drinking water wells within a 1/2-mile radius of the proposed project?
Yes ____ No X

Explanation and Source:

No public or private drinking wells are located in the City of Boston. The City's water is supplied by the MWRA/MDC from the Quabbin Reservoir in western Massachusetts.

6. Might the operation of the project result in any increased consumption of water? Yes X No ____
Approximate consumption * gallons per day. Likely water source(s) MWRA/MDC

Explanation and Source:

*81,365 - 120,750 gallons, depending on development option

Sanitary sewage +15%

7. Does the project involve any dredging? Yes ____ No X
If Yes, indicate:
Quantity of material to be dredged ____
Quality of material to be dredged ____
Proposed method of dredging ____
Proposed disposal sites ____
Proposed season of year for dredging ____

Explanation and Source:

The project site is not located on any shoreline.

G. Air Quality

1. Might the project affect the air quality in the project area or the immediately adjacent area?
Yes X No ___
Describe type and source of any pollution emission from the project site. TSP, CO, NO_x

Short-term air quality effects will occur during construction, particularly dust emissions from site preparation and excavation and pollutant emissions from construction equipment. Wetting of the site can reduce dust emissions significantly. The additional vehicular traffic generated by the project will result in increases in auto-related pollutants in the project vicinity. The project will be monitored to ensure that the impact on the residents of the area will be minimized.

2. Are there any sensitive receptors (e.g., hospitals, schools, residential areas) which would be affected by any pollution emissions caused by the project, including construction dust? Yes X No ___

Explanation and Source:

The Whittier Street and Mission Hill Extension public housing projects, other residential properties in the Lower Roxbury area, and Northeastern University are located adjacent to or in close proximity to the project site. Special attention will be given to measures that mitigate the adverse effects of the project on air quality in Roxbury. The surrounding community will have an opportunity to comment on these mitigation measures.

3. Will access to the project area be primarily by automobile? Yes X No ___
Describe any special provisions now planned for pedestrian access, carpooling, buses and other mass transit.

The project site is located adjacent to the new Ruggles Street station in the Ora Line rapid transit system, which also will be a stop for commuter rail service from Route 128 to South Station and for approximately 10 MBTA bus routes. In accordance with City policy, the redeveloper will be required to submit an Access Plan outlining measures to manage auto access to the project. The community will have the opportunity to comment on the access plan.

H. Noise

1. Might the project result in the generation of noise? Yes X No ___

Explanation and Source:
(Include any source of noise during construction or operation, e.g., engine exhaust, pile driving, traffic.)

Short-term noise effects will occur during the construction period, particularly from pile-driving operations. Noise attenuation measures will be required to reduce the noise impacts to the extent feasible. In the long-term, some increas in community noise levels could result from the increase in area traffic, and the more active use of the site. Special attention will be given to measures to mitigate the adverse effects of noise on the Roxbury community.

2. Are there any sensitive receptors (e.g., hospitals, schools, residential areas) which would be affected by any noise caused by the project? Yes X No ___

Explanation and Source:

The Whittier Street and Mission Hill Extension public housing projects, other residential properties in the Lower Roxbury area, and Northeastern University are located adjacent to or in close proximity to the project site. Mitigation measures will be implemented during construction to minimize noise impacts on these residential and institutional areas.

I. Solid Waste

1. Might the project generate solid waste? Yes X No ____

Explanation and Source:

(Estimate types and approximate amounts of waste materials generated: e.g. industrial, domestic, hospital, sewage sludge, construction debris from demolished structures.)

Construction of the project will result in the generation of excavation material for building foundations and subsurface parking and of normal construction and building debris. The completed project will generate approximately 3.95 to 5.9 tons of solid waste per day, depending on the development option ultimately selected.

J. Aesthetics

1. Might the project cause a change in the visual character of the project area or its environs? Yes X No ____

Explanation and Source:

The project will add a mid- or high-rise development to an area consisting primarily of vacant land and low-scale buildings. The development will replace an unattractive open parking lot with urban active mixed-use complex which is expected to create its own place while stimulating further compatible development on surrounding sites. In order to assure the appropriate siting and design of the project in relation to the Roxbury community, the project will be planned and developed with extensive community participation and review.

2. Are there any proposed structures which might be considered incompatible with existing adjacent structures in the vicinity in terms of size, physical proportion and scale, or significant differences in land use? Yes X No ____

Explanation and Source:

The scale and height of the proposed development are different from the existing scale of the surroundings. However, preliminary design guidelines have been developed to assure that the project will be compatible with the surrounding environment and will be completed with community participation and reciew. A 75-foot cornice line, consistent with those along Tremont Street, is to be maintained, with any additional height set back a minimum of 20 feet.

3. Might the project impair visual access to waterfront or other scenic areas? Yes ____ No X

Explanation and Source:

The project is not located near any waterfront area or any scenic area and therefore will have no effect on visual access to such areas.

K. Wind and Shadow

1. Might the project cause wind and shadow impacts on adjacent properties? Yes X No ____

Explanation and Source:

If high rise buildings are developed on the site, they could result in wind and shadow impacts on the surrounding area. To mitigate these impacts the towers should be setback from the street to limit wind problems. Wind-tunnel analyses and shadow studies will be included in the Draft Environmental Impact Report. Special attention will be given to mitigation of wind 38 and shadow on the surrounding area.

IV. CONSISTENCY WITH PRESENT PLANNING

A. Describe any known conflicts or inconsistencies with current federal, state and local land use, transportation, open space, recreation and environmental plans and policies. Consult with local or regional planning authorities where appropriate.

The Parcel 18 development will be designed in response to the development concept and urban design guidelines developed by the Boston Redevelopment Authority in consultation with the Parcel 18+ Task Force for the development of this site as well as to contribute to fulfilling the objectives of the City's parcel-to-parcel linkage program. The site design will accommodate the Southwest Corridor open space system, and the proposed development will be subject to review by the Boston Civic Design Commission. It is the objective of this

(continued on back page)

V. FINDINGS AND CERTIFICATION

A. The notice of intent to file this form has been/will be published in the following newspaper(s) :

(Name)	(Date)
Boston Herald	June 27, 1986
Bay State Banner	July 5, 1986
South End News	July 5, 1986

B. This form has been circulated to all agencies and persons as required by Appendix B.

June 30, 1986
Date

Signature of Responsible Officer or Project Proponent

Stephen Coyle, Director
Name (print or type)

Address Boston Redevelopment Authority
Boston City Hall
Boston, MA 02201

Telephone Number 722-4300

June 30, 1986
Date

Signature of person preparing ENF (if different from above)

Richard B. Mertens orIvy Dilworth
Name (print or type)

Address Boston Redevelopment Authority
~~Boston City Hall~~
Boston, MA 02201

Telephone Number 722-4300 X323

THE COMMONWEALTH OF MASSACHUSETTS
EXECUTIVE OFFICE OF ENVIRONMENTAL AFFAIRS

MICHAEL S. DUKAKIS
GOVERNOR

JOHN DEVILLARS
SECRETARY

May 22, 1989

CERTIFICATE OF THE SECRETARY OF ENVIRONMENTAL AFFAIRS
ON THE
DRAFT ENVIRONMENTAL IMPACT REPORT

PROJECT NAME	: Parcel 18
PROJECT LOCATION	: Boston
EOEA NUMBER	: 6133
PROJECT PROPONENT	: Boston Redevelopment Authority
DATE NOTICED IN MONITOR	: April 13, 1989

The Secretary of Environmental Affairs herein issues a statement that the Draft Environmental Impact Report submitted on the above project adequately and properly complies with the Massachusetts Environmental Policy Act (G.L., c.30, s.61-62H) and with its implementing regulations (301 CMR 11.00).

The format and readibility of the Draft Environmental Impact Report (DEIR) for the proposed redevelopment of Parcel 18 is quite good. The document provides an excellent basis for comparing the environmental and socio-economic impacts of the five alternatives developments which were considered.

The Final Environmental Impact Report (FEIR) must focus on the preferred (developer's) alternative and provide more details regarding the impacts of this proposal on the areas of traffic, massing and shadow, wind, sewer, socio-economics, etc. The report must identify the mitigation which is warranted and the party or parties who will be responsible for implementing such mitigation. The FEIR must also include individual responses to the comments which were submitted on the DEIR by others and must include Draft Section 61 Findings which summarize the

mitigative elements of the project for all impact areas which were scoped.

May 22, 1989
DATE

JOHN P. DeVillars, SECRETARY

Comments received: Roxbury Community College 5/1/89
Boston Water and Sewer 5/12/89
MA Water Resources Authority 5/16/89
MDC 5/12/89

JD/JW/jiw

Kramer Associates
80 Hovey Street, Watertown, MA 02172 (617) 923-9973

October 23, 1989

Mr. Steven Davis
Director, MEPA Unit
Executive Office of Environmental Affairs - Room 2000
100 Cambridge Street
Boston, MA 02202

RE: EOEA #6133 — Ruggles Center FEIR

Dear Mr. Davis:

This letter is written to confirm understandings reached on how we will complete the Ruggles Center FEIR and respond to certain comments received from public agencies that reviewed the DEIR. The points referenced below were discussed with you and Jacki Wilkins at our July 13 meeting, and upon your direction, we had additional discussions with the EOTC and MBTA on August 1.

At our July 13th meeting with you, we discussed our general approach to the FEIR and the treatment of certain comments received on the DEIR. We reached agreement on a number of points and you suggested that several issues be resolved with EOTC.

At the July 13th meeting, we agreed that:

1) The design year will be 1996:

2) Issues regarding the traffic growth rates and additional Cass Boulevard intersections to be analyzed should be resolved in a separate meeting with EOTC;

3) Comments on traffic impacts at Hammond Street/Tremont Street, Columbus Avenue/Cedar Street, Hammond Street/Shawmut Avenue, "Blue Hill Avenue Corridor," Egleston Square to Massachusetts Avenue" and "Ruggles to Massachusetts Avenue" could be addressed in the comments section, without new analyses in the body of the text.

4) No new analysis for air and noise is required for the FEIR at intersections already analyzed in the DEIR. For new intersections to be analyzed, if the

intersections operate at LOS D and the project does not add more than 10% to background traffic, no new analysis is required.

If the new intersections operate at LOS E or F and project traffic exceeds 10% of total volumes on the affected approaches, new air analysis is required.

At the August 1 meeting with EOTC and the MBTA, it was agreed that:

1) The growth rate methodology employed in the DEIR is acceptable.

2) The background developments (the 'no-build network') included in the DEIR, as revised in July, 1989 by the BRA, are a reasonable indicator of background development for the 1996 design year; and,

3) It is acceptable to analyze only the two intersections of Massachusetts Avenue/Cass Boulevard and Washington Street/Cass Boulevard in response to the EOTC comment for additional analyses at "major" Cass Boulevard intersections.

We are proceeding with our completion of the FEIR and intend to use these agreements as our guidelines.

Thank you for meeting with us and good luck in your new ventures.

Sincerely yours,

Lois Kramer

Lois S. Kramer
FEIR Coordinator

cc: Jacki Wilkins, MEPA Unit
Lori Steans, EOTC
Peter Calcaterra, MBTA
Sylvia Hill, MBTA
John Neuwirth, MBTA
Dick Mertens, BRA
Juan Carlos Loveluck, BRA
Paul Chan, Metropolitan/Columbia Plaza Venture
Jane Howard, Howard/Stein-Hudson Associates, Inc.

Response to Comments

This section responds directly to comments made by reviewers of the Draft Environmental Report for Ruggles Center. The Executive Office of Environmental Affairs and the Boston Redevelopment Authority received nine sets of comments from the following government agencies, groups and individuals:

1.0 Metropolitan District Commission
2.0 Massachusetts Water Resources Authority
3.0 Boston Water and Sewer Commission
4.0 Roxbury Community College
5.0 Mary Ann Nelson
6.0 Paul Parks and Associates, Inc.
7.0 Executive Office of Transportation and Construction
8.0 Richard Heath
9.0 Parcel 18+ Development Task Force

Copies of these letters are included along with the project proponent's response. Each letter was assigned a number as indicated above. In addition, individual comments within each letter were identified by sub-section numbers, located in the left margin of each page. These sub-section numbers correspond to specific responses prepared by the project proponent.

The Commonwealth of Massachusetts
Metropolitan District Commission
M. Ilyas Bhatti, Commissioner

20 Somerset Street
Boston, MA 02108
617-727-5114

The Metropolitan Network of Services

Parks

Beaches

Community Boating

Historic Sites

Recreational Facilities

Public Concerts

Trailside Museum

Boston Harbor Islands

Metropolitan Police

Flood Control

Watershed Management

Pure Water Supply

Quabbin, Wachusett and Sudbury Reservoirs

Franklin Park and Stone Memorial Zoos

Parkway, Boulevard and Bridge System

Charles, Mystic and Neponset Rivers

Beaver Brook, Blue Hills, Elm Bank, Breakheart, Middlesex Fells, and Stony Brook Reservations

May 12, 1989

Mr. Steven C. Davis, Assistant Secretary
Executive Office of Environmental Affairs
MEPA Unit
100 Cambridge Street - Room 2000
Boston, MA. 02202

RE: Parcel 18; EOEA #6133

Dear ~~Mr. Davis~~: Steve

The Metropolitan District Commission is pleased to have this opportunity to comment on the above-referenced Draft Environmental Impact Report (DEIR). The DEIR does a good job of delineating and discussing the facts surrounding this project. There are, however, some items which should be discussed in a Final Environmental Impact Report (FEIR). These items come under the following topic headings:

Public Access/Bicycle and Pedestrian Path: As you know, the MDC currently has care and control of the Southwest Corridor Park, which this project abuts. The project proponent, through rights transferred by the MBTA, may, in future, utilize some land currently in use as a bicycle and pedestrian path. At present, a Memorandum of Understanding (MOU) has been designed which will enable the public to have continued access via the bicycle/pedestrian path and surrounding greenspace. As has been agreed with the MBTA, the MOU will provide for a permanent easement enabling the MDC to have care and control
1.1 of these public spaces. The location of the bicycle/pedestrian path and green space has not yet been finalized but the FEIR should clearly delineate them.

Shadow/Building Heights: Happily, there is little difference between the public amenities (e.g., housing) shown in Alternative 3 (14 story Office Building) and Alternative 4 (9 story Office Building). The different building heights and the shadows they cast cause the major changes between the two alternatives. Alternative 4 appears to be the most compatible with its surroundings, both aesthetically and in terms of shadow impacts. The FEIR should delineate shadow impacts on the bicycle/pedestrian path and greenspace,
1.2 assuming the location of these items has been determined by the completion of the FEIR.

Thank you for this opportunity to comment.

Sincerely,

M. Ilyas Bhatti,
Commissioner

MIB/DQ

cc: A. Morris

MetroParks MetroParkways MetroPolice PureWater

1.0 Metropolitan District Commission

Comments From: M. Ilyas Bhatti
Dated: May 12, 1989

1.1 Clearly delineate final location of bicycle/pedestrian path and green space.

The Southwest Corridor Park currently allows bicyclists to travel its entire length alongside pedestrians. This is made possible through a combined, paved bikeway/sidewalk that is an integral part of the landscape features of the park itself. Certain locations are clearly marked with information kiosks that identify the designated bicycle route up and down the Corridor. Although the bikeway/sidewalk varies in width along the length of the Corridor, it opens up to an expansive, thirty-foot wide paved area at the Columbus Avenue/ Melnea Cass Boulevard intersection and passes through the project site up to the Ruggles Station entry. The Master Plan Design proposes to maintain the continuity of this thirty-foot wide area and enhance it with appropriate landscape features. In order to minimize potential conflicts between pedestrians and cyclists, the paved area may be designated for pedestrian use on the portion closest to the garage building, while the portion next to the street would be for cyclists. Only one curb cut is proposed for vehicular access through the project site and appropriate signage will be installed to slow automobile traffic crossing the bikeway at that point. Figure II A-28 shows the routing of the bicycle path.

Figure II E-3 shows the open space elements for the Master Plan Design. Please refer to Chapter II, Section E, Open Space for a full discussion of the open space design.

1.2 Delineate shadow impacts on bicycle/pedestrian path and greenspace.

The proposed Master Plan massing will introduce a net increase in shadows as is inevitable when new buildings are placed in the middle of a previously open area. For the key location, Ruggles Street Station, new shadows will occur primarily in the morning at the South entrance and bus platforms. Shadow impact on the Southwest Corridor Park is minimal and limited to a very small portion at its eastern

end. The Ruggles Street Station Park is in almost full sunlight midday and in the afternoon during the spring and summer when it is likely to have the greatest use. Afternoon shadows occur primarily in the winter and are noticeably reduced during the spring and fall. It should be noted that, by providing a space between the pairs of proposed buildings, a corridor of sunlight is maintained during those times of the day and year when building shadows do not overlap. The Ruggles Center Plaza will be in partial shadow in the early morning throughout the year, with the least amount of morning shadow falling during the winter. The plaza will be in full sun by late morning in winter and in spring, and by noon in summer and fall, when lunchtime use of the space is expected to be most frequent. By mid-afternoon, the Plaza will be in shadow throughout the year, but will receive some later afternoon sun, especially during the summer.

MASSACHUSETTS WATER RESOURCES AUTHORITY
Charlestown Navy Yard
100 First Avenue
Boston, Massachusetts 02129
Telephone: (617) 242-6000

RECEIVED
MAY 17 1989
MEPA

May 16, 1989

John P. DeVillars, Secretary
Executive Office of Environmental Affairs
100 Cambridge Street
Boston, MA 02202

Attn: MEPA Unit

Re: EOEA No. 6133 - Parcel 18 DEIR, Boston

Dear Secretary DeVillars:

Concerning the above-referenced Final Environmental Impact Report (FEIR), we submit the following comments:

2.1 The proposed project will be increasing wastewater flow to the Boston and MWRA Sewer Systems by 76,750 to 105,000 gpd, depending on the development option. Considering the problems involving CSO's and the limited capacity of the collection and treatment systems, we consider this additional flow significant enough to warrant compensation through infiltration/inflow reduction. In the Final Environmental Impact Report, the proponent should identify mitigation measures to satisfy the 2:1 I/I reduction required by DEQE.

2.2 The proponent should be aware that the building will be constructed over the MWRA Boston Main Drainage Tunnel. Coordination with the MWRA is necessary.

We appreciate the opportunity to comment. Should you have any questions, please do not hesitate to call me at (617) 241-6238.

Very truly yours,

Katina Belezos, Project Engineer
Tech Support Unit
Wastewater Engineering

KB:bf/T31-157

2.0 Massachusetts Water Resources Authority

Comments From: Katrina Belezos, Project Engineer
Dated: May 16, 1989

2.1 To accommodate increase in wastewater flow, identify mitigation measures to satisfy the 2:1 infiltration/inflow reduction required by DEP.

The MWRA is presently preparing a study of the combined sewer overflow (CSO) system that will make recommendations on methods for eliminating or minimizing the impact of CSO's on the water quality of receiving waters. A draft version of this report is due to be made available in January, 1990 with the final report filed in mid-1990. Until such time as the recommendations of that report are known, both the MWRA and BWSC have agreed that the best available method of reducing the CSO impact on receiving waters is to minimize the volume of sanitary flow exposed to overflow conditions by separation of dry and wet weather flows and by the use of water conservation measures to reduce the volume of sanitary flows generated.

The sewer system servicing the proposed site area was reconstructed, to a large extent, during the Southwest Corridor Project construction. The systems to which the project flows will be discharged have been separated. Ruggles Center will moderate sewer flows by implementing and using water conserving facilities and practices required by the Massachusetts Plumbing Code and other design elements.

The developer will be preparing a water and sewer site plan during the design phase which will detail the project service connections, projected flows at each location and other pertinent design information. These plans will be submitted to both the MWRA and BWSC for approval prior to the issuance of service connection permits by DEP.

2.2 Coordinate any construction over drainage tunnels with the MWRA.

The southwest corner of the site (at the corner of Ruggles and Tremont Streets) is traversed by a 50 foot wide easement. This

easement contains the 10 foot wide Boston Main Drainage Tunnel, currently under the jurisdiction of the MWRA. The tunnel, which is approximately 300 feet underground, carries effluent from the Ward Street Headworks to the Deer Island Treatment Plant. The proposed building has been designed to cover this easement at ground level. The developer will coordinate closely with the MWRA on this and all building and design which involves water mains and drainage tunnels.

Boston Water and Sewer Commission

425 Summer Street
Boston, MA 02210-1700
617-330-9400
Fax 617-330-5167

RECEIVED
15 1989
MEPA

May 12, 1989

Secretary John P. DeVillars
Executive Office of Environmental Affairs
20th Floor
100 Cambridge Street
Boston, Massachusetts 02202

Attention: MEPA Unit

Re: Parcel 18, EOEA #6133

Dear Secretary DeVillars:

The Commission has reviewed the Draft Environmental Impact Report (DEIR) submitted for the proposed Parcel 18 Development. We have a number of concerns regarding the project, which we feel should be addressed in the Final Environmental Impact Report (FEIR). A list of our concerns is given below.

3.1 1. Several water and sewer lines are shown incorrectly in the DEIR. The project proponent should obtain up-to-date system plans from the Commission's Engineering Services Division, and revise the FEIR accordingly.
3.2 All street names, water main, sewer and storm drain sizes should be clearly shown on figures provided in the FEIR.

3.3 2. No buildings are to be constructed over water mains. If construction over sewers or storm drains is planned, the proponent must obtain a license agreement from the Commission, to build over the facilities. In the FEIR the proponent should indicate how access for repair and maintenance of these facilities will be provided.

3.4 3. In estimating the water demands and sewer flows, the proponent refers to "BWSC typical sewage discharge standards". The Commission does not have such standards, although the sewer flow estimations provided by the DEQE in its Title V regulations are referred to in our Site Plan Requirements. The proponent should note that Title V does not give sewage discharge estimations for retail, cultural, or day-care space.

3.5 4. The calculations for water demand should include a separate figure for air conditioning make-up water.

5. If potable water is to be used for irrigation of landscaped areas then this number should also be calculated. Serious consideration should be given to creating a landscape or installing an irrigation system that requires minimal use of water.

3.6 6. Installation of 24-hour sewer retention system as decribed on page 136, is not recommended by the Commission.

3.7 7. The proposed project involves dewatering and installation of driven piles to support the foundation. The proponent should be aware that discharge of groundwater to the sewer or storm drain system on a permanent basis is prohibited. Discharge of groundwater to storm drains may be permitted on a temporary basis, provided that the proponent obtains a permit from Engineering Services.

3.8 8. The Commission recommends that wells installed for the purpose of observing groundwater levels be installed on a permanent basis. The location of the observation wells should be indicated on any plans submitted to the Commission in the future.

We thank you for this opportunity to comment on this project. If there are questions regarding the above comments, please contact me.

Yours truly,

John P. Sullivan, Jr., P.E.
Chief Engineer

JPS/LB/AK/gf
cc: Stephen Coyle - BRA
Att: Richard Mertens - BRA

3.0 Boston Water and Sewer Commission

Comments From: John P. Sullivan, Jr., P.E.
Dated: May 12, 1989

3.1 Include up-to-date water and sewer system lines.

Please refer to Figure II B-2 and Figure II B-3 for up-to-date maps of the water service system and the sewerage system. The information in these figures was taken from BWSC maps of the area.

3.2 Show clearly all street names, water main, sewer and storm drain sizes figures.

Please refer to Figure II B-2 and Figure II B-3 for this information.

3.3 No buildings are to be constructed over water mains. Where construction over sewers or storm drains is planned, indicate access for repair and maintenance and identify license agreements to be obtained from BWSC.

Where construction over, or adjacent to, sewers, drains or mains is planned, relocation of, or access to, these lines for repair and maintenance will be provided by the developer in accordance with the requirements of and subject to the approval of BWSC.

3.4 Clarify sewage estimates.

The estimates for water and sewer demand in the FEIR were prepared by the project engineers who are designing these systems for Ruggles Center and are based on a more complete understanding of actual project requirements than was known at the time when the DEIR was prepared. The sewer discharge standards applied are consistent with the Commonwealth of Massachusetts, Title V standards and with professional practices for projecting water uses and sewage needs.

Please refer to Chapter II, Section B for a full discussion of methodology and projected water and sewer demand.

3.5 Include air conditioning make-up water and water for irrigation of landscaping in calculations for water demand.

See Table II B-1 for separate estimates of air conditioning make-up water. No irrigation system is currently planned for Ruggles Center. Landscaped areas will depend on available rainfall for irrigation.

3.6 24-hour sewer retention system is not recommended.

A 24-hour sewer retention system will not be used.

3.7 Obtain BSWC permit for temporary discharge of groundwater to sewer or storm drain system in connection with installation of driven piles.

It should be noted that three of the buildings at Ruggles Center involve at grade construction and do not require deep excavation. For Buildings 3 and 4 where an underground parking garage is planned, the project proponent will obtain a BSWC permit for temporary discharge of groundwater to sewer or storm drain system. Groundwater withdrawn from the site during construction will be pumped to a siltation settling tank/basin to remove fine material, prior to discharge into the existing storm drain system.

3.8 Install wells for observing groundwater levels on a permanent basis and indicate on any plans submitted to BWSC.

Permanent observations wells will be installed around the perimeter of permanent, below groundwater level structures, such as the deep parking garages proposed for Buildings 3 and 4. A monitoring program will be instituted to measure groundwater levels throughout the life of the structure if portions of the structure basement are below groundwater level. The project proponent will provide BWSC with the necessary information about permanent observation wells.

ROXBURY COMMUNITY COLLEGE

1234 Columbus Ave.
Roxbury Crossing
MA 02120-3400

(617) 427-0060

RECEIVED
4 1989
MEPA

May 1, 1989

John P. DeVillars,
Secretary
Executive Office of Environmental Affairs
100 Cambridge Street,
Boston, MA 02202

Att: MEPA Unit

RE: EOEA #6133 - Parcel 18 Development

Dear Mr. DeVillars:

Roxbury Community College wishes to offer the following comments on the Referenced DEIS:

Traffic Impacts. Although improvements in facilitating anticipated traffic increases are planned at the principal intersections feeding the Parcel 18 site, the improvements going southwesterly from the Parcel 18 site stop at Roxbury Crossing, the intersection of Tremont/Columbus/New Dudley.

Roxbury Community College fronts on Columbus Avenue, just southwesterly of the Tremont/Columbus/New Dudley intersection. The four buildings of the College are in the block between New Dudley Street and Cedar Street. The College parking lot, 300 car capacity, lays between Cedar St. and New Heath Street on Columbus Avenue and is accessed from Cedar Street. The Columbus Avenue-Cedar Street intersection has signals, sequenced only for through traffic.

4.1 This particular intersection is the scene of frequent accidents. Vehicles outbound from Boston making a left turn from Columbus Avenue onto Cedar Street do so at considerable risk. Vehicles heading northeasterly on Columbus Avenue are also at risk in attempting to turn right onto Cedar Street. The perilousness of this particular intersection has been apparent to the College all through the construction of the campus and during our occupancy.

The College has written several letters, dating from 1986, to the Boston Traffic Department calling attention to the hazards that exist. Just within the past week the Traffic Department has restriped the breakdown lanes on Columbus Avenue, both inbound and outbound, creating a right turn lanes which should offer limited improvement. There is no relief for left turning vehicles.

The traffic projections through 1993 of the DEIR depict increases of from 13% to 18% for the No Build and the 19 Story Office Buildings alternatives. With increases of this magnitude the present traffic problems at the intersection of Columbus Avenue and Cedar Street will intensify to an alarming degree.

Despite the College's concerns and anxiety regarding the perceived traffic problems directly affecting the College, we enthusiastically support the development of Parcel 18 as a major step in the revitalization of Roxbury.

Sincerely,

William B. D. Thompson

William B. D. Thompson
Acting President

cc: Boston Redevelopment Authority
Boston Transportation Department

4.0 Roxbury Community College

Comments From: William B. D. Thompson, Acting President
Dated: May 1, 1989

4.1 Concerns are expressed over traffic operational effects at the Columbus Avenue/Cedar Street intersection, through which Roxbury Community College traffic must gain access.

The project proponent shares concern over the lack of safety controls and barriers (specifically, left turn storage lanes) at minor intersections along the Southwest Corridor roadways of Tremont Street and Columbus Avenue. Vehicle trips associated with the Ruggles Center development comprise less than 3% of total peak hour traffic volumes along Columbus Avenue south of New Dudley Street. In this respect, vehicle trips related to Ruggles Center are not expected to impact traffic and safety operations at the intersection of Columbus Avenue and Cedar Street.

The project proponent will, however, identify the condition and suggest possible solutions to the problem to the appropriate City and/or State agencies.

LATE COMMENT

10 Gore Street
Boston, MA 02120

RECEIVED
MAY 25 1989
MEPA

24 May 1989

Secretary John P. DeVillars
Executive Office of Environmental Affairs
Attention: MEPA Unit
100 Cambridge Street
Boston, MA 02202

Dear Secretary DeVillars,

Today, I came across a copy of the Draft EIR for the Parcel 18 Development, EOEA # 6133. For a number of years, I have ridden the Southwest Corridor Park Bike Path as a regular user. I reviewed the DEIR for the project's impacts on the bike path and its many users. The report contains almost no analysis of the project's impact on the Southwest Corridor Park. The report also fails to consider bicycle commuting as an
5.1 option under transportation.

The FEIR should discuss the impacts of the development on the bike and
5.2 pedestrian paths within the park. Merely stating the right of way will continue to exist is not enough. How will the project interface with the park? The DEIR fails to discuss the interaction of bicycle traffic with pedestrian traffic on the pedestrian and bike paths. It appears to me that the bicycle path will become part of the pedestrian area around the
5.3 buildings. This could result in conflicts between pedestrians and bicyclists, especially during peak commuting times.

5.4 The report does not discuss the impact automobiles may have on the bike and pedestrian paths. Must automobiles cross the paths to enter garages? What impact will traffic have on bicyclists and pedestrians as the paths
5.5 cross Prentiss Street?

The DEIR did not discuss the construction impacts on the Southwest Corridor Park and its users. What are the impacts? Will this part of the
5.6 park be closed during construction?

The final architectural design of the buildings will determine the true
5.7 impact of the project on the Southwest Corridor Park. What will we see as we bicycle, walk, cross-country ski along the path? I hope that the BRA will allow citizens to participate in the design review of the project if it is built.

Due to the timing in submission of these comments, I've limited them to the bicycle path.

Thank you very much.

Sincerely,

Mary Ann Nelson

Mary Ann Nelson

5.0 Mary Ann Nelson

Dated: May 24, 1989

5.1 DEIR fails to identify bicycling as an access option under transportation modes.

Because detailed trip generation rates for bicycles have not been developed by ITE or others, bicycles are assumed to account for about 10 percent of the "walk/other" mode in the peak hours and 3 percent of total daily "walk/other" trips. (See Table II A-26.) It is assumed that bicycle travel will be more commuter-oriented and thus more highly concentrated during the peak hours than overall walk trips.

Based on this assumption, there will be about 80 bicycle trips per day. Approximately 20 bicyclists will enter the site in the morning and 20 will leave the site in the evening. The remainder will cross the site throughout the day.

5.2 Interface of project with Southwest Corridor Park.

Ruggles Center is an integral part of the Southwest Corridor development program. The project therefore integrates its own access needs with those of Ruggles Station and the Southwest Corridor. The architect for the development was the station designer, and is well aware of these issues.

The pedestrian path and bikeway will be kept continuous through the site, although the sharing of the way by both pedestrians and bikes has to be accepted in a limited space area. This is not uncommon at an urban activity center like the proposed development with the adjacent station. Routings will be retained during construction, but some detouring will likely be necessary during certain phases of the work.

5.3 Identify site area conflicts between pedestrians & bicycles.

The main point of conflict between pedestrians and bicycles occurs at the existing Ruggles Station entrance on Columbus Avenue Extension, adjacent to the dropoff/pickup area. At this location, pedestrians entering/exiting the station share space with bicyclists.

The bicycle path, which is separate from the pedestrian path south of the station entrance, merges with the sidewalk at this location. Some bicyclistsmay go into the street area to avoid pedestrians but might then compete with cars that are dropping off or picking up passengers.

Overall pedestrian use of this area is low, with most using the Ruggles Station and others transferring from feeder buses operating internally to station. A Howard/Stein-Hudson survey at the station entrance/exit found that 186 people cross this sidewalk during the morning peak hour and 206 people cross during the evening peak hour. These people share space with 34 bicyclists in the morning peak period and 41 bicyclists during the evening peak period.

When Ruggles Center is built, pedestrian activity at the station entrance/exit is expected to increase from 186 to approximately 300 pedestrians during the morning peak hour period. An increase in bicycle use of the path adjacent to the site from 34 bicyclists to 50 bicyclists during the morning peak hour is expected to increase conflicts at this location. The number of bicycles is projected to increase from approximately one bicycle passing every two minutes to almost one bicycle passing this location per minute.

To minimize potential problems, the project proponent proposes to continue the separation of the pedestrian and bicycle path designation through the Ruggles Center site. Pedestrians will be directed to use the inner half of the sidewalk and bicyclists the outer half. Bicyclists will be advised to reduce their speed as they cross the Ruggles Center site and be advised of heavier pedestrian activity at the Ruggles Station entrance/exit. (Refer to Figure II A-28 for an illustration of the proposed bicycle path.)

5.4 Automobile access conflicts with bicycles and pedestrians.

As stated in response to comment 5.3, automobiles and bicyclists both use the roadway when bicyclists leave the bicycle path to avoid pedestrian activity associated with the station entrance/exit. These potential conflicts are low due to the low volumes of existing vehicular and bicycle activity. Future pedestrian, bicycle and vehicular activity at this location, however, will require appropriate signage and pavement markings to direct pedestrian, bicycle and vehicular movements along the desired alignments and designated pathways for each individual use.

Another location where automobiles share roadway with bicycles and pedestrians occurs at the parking garage entrance/exit on Columbus Avenue Extension. Under the Master Plan Design, the pedestrian and bicycle paths will cross the entrance/exit to the parking garage approximately 200 feet north of the station entrance. Signage will be installed to increase safety for pedestrians, bicyclists and vehicles at this location. In addition, vehicles will be required to stop before crossing the pedestrian and bicycle paths while entering and exiting the garage.

5.5 Describe any vehicle/bicycle/pedestrian conflicts at Prentiss Street.

The impacts of vehicular conflicts with pedestrians and bicycles at Prentiss Street have not been identified as part of this study. Visual observations at this location, however, indicate that conflicts are most likely to occur where the Southwest Corridor Pedestrian/Bicycle path crosses Prentiss Street. Since traffic generated by Ruggles Center is not expected to use Prentiss Street, there will be no increase in vehicular conflicts with pedestrian or bicycle activities attributable to the project.

5.6 Identify any construction impacts on the Southwest Corridor Park and its users, such as partial closing during construction.

Ruggles Center is a phased development. The project proponent does not anticipate that any portion of the Southwest Corridor Park, outside the Ruggles Center site, will be significantly impacted or closed during construction. Bicycle and pedestrian paths on the site may require temporary relocation for short periods of time to assure the safety of park users. The project proponent will see that continuity of the Southwest Corridor Park is maintained in a safe manner during all phases of construction.

5.7 Identify visual impacts on users of paths. Identify opportunities for citizen participation in design review of the project.

The project proponent believes that Ruggles Center will provide a new center of urban activity at this location. Project architects have worked hard to achieve a visual impact for Ruggles Center that is both exciting and well integrated with the surrounding area.

Chapter II, Section C provides a full visual analysis of Ruggles

Center. View corridors, views from distant points and perception from the person-on-the-street point of view were of considerable importance in determining the site layout, massing concept and architectural character for the Master Plan Design. Both the north and south Tremont Street approaches were regarded as primary vantage points for pedestrians and motorists. Buildings were situated next to the property line to address the street in a "traditional Boston" manner and define a street wall where currently none exists. From the Melnea Cass Boulevard approach, the overall scale and character of the proposed project is revealed from an angular view-point which allows for identification of each individual building element. The Melnea Cass Boulevard/Tremont Street intersection was considered for its high visibility and is accentuated with an octagonal massing element at the corner of the first building. Even though Columbus Avenue terminates at the project site, the long view is interrupted by a bend in the street six blocks to the north. However, provision for a fitting visual terminus is realized in the 12-story curved, rear corner of the hotel building. This corner also "marks' the site from vantage points west of the site. Since the entry portal to Ruggles Station has become a visual landmark in the area, it was considered too prominent to be obscured by new buildings. The creation of the linear plaza opening onto Tremont Street allows for direct visual access to the station entry to be maintained.

Many groups, notably the Parcel 18+ Development Task Force, have been involved with review of the design and will continue their involvement. The project proponent has contributed $36,000 to the Parcel 18+ Task Force and Chinatown Neighborhood Council to facilitate greater participation over the next two years in project planning and review. An additional $64,000 will be contributed, totalling $100,000 over a two year period.

PAUL PARKS AND ASSOCIATES, INC

PAUL PARKS, R P E
PRESIDENT
JOHN O'S. FRANCIS MBA
SR VICE PRESIDENT

CONSULTANTS
CIVIL ENGINEERING
STRUCTURAL ENGINEERING
URBAN PLANNING
HOUSING PLANNING & DEVELOPMENT
HEALTH SYSTEM PLANNING & DEVELOPMENT
EDUCATION PLANNING
TRANSPORTATION SYSTEMS PLANNING
& EVALUATION
CIVIL RIGHTS INVESTIGATION
ENERGY SYSTEMS PLANNING
& EVALUATION

SUITE 815
100 BOYLSTON STREET
BOSTON MASSACHUSETTS 02116
(617) 451-3688

RECEIVED
MAY 23 1989
MEPA

22nd May 1989

Mr. John P. Devillars
Secretary
Executive Office of Environmental Affairs
100 Cambridge Street
Boston, MA 02202

ATTN: MEPA Unit

RE: Environmental Impact Report
Parcel 18 Development/EOEA No. 6133

Dear Sir:

I have reviewed the draft Environmental Impact Report for the Parcel 18 Development (EOEA No 6133) located in the Roxbury neighborhood of the City of Boston. I was quite impressed with the thoroughness of the report.

The major comments that I feel compelled to make relates to the traffic enigma. The problem is particularly criticle at Tremont and Ruggles streets. The mass of traffic and the volume of pedestrians make it necessary to separate the pedestrian traffic from the vehicular traffic. I would suggest some sort of
6.1 overhead walkway for the pedestrians.

I further believe that given the volume of traffic on Tremont
6.2 street and Columbus avenue, it is necessary to develop another major artery system that accesses downtown to relieve the pressure on the above mentioned roadway.

I would like to suggest the development of Blue Hill avenue from the Milton line into the Melnea Cass boulevard as a possibility. I believe the development of this arterial system would dramatically relieve the pressure, as well as open up the area along Blue Hill avenue to major development.

I hope that my suggestions are helpful to you.

Sincerely,

Paul Parks, R.P.E
President

PP/ga

6.0 Paul Parks and Associates, Inc.

Comments From: Paul Parks, RPE
Dated: May 22, 1989

6.1 Proposes overhead walkway to separate vehicles and pedestrians.

Pedestrian demand across Tremont Street adjacent to the Ruggles Center site is moderate at the present time (less than 200 persons during the peak hour). Current pedestrian and bicycle activity crossing Ruggles Street is light and occurs primarily at the Southwest Corridor pedestrian/bicycle path. The existing actuated crosswalk signals at the Tremont Street intersection with Ruggles and Whittier Streets and at Tremont Street and Ruggles Street South are adequate to handle current pedestrian demand across Tremont Street.

The pedestrian actuated signal at the intersection of Ruggles Street and the Busway exit sufficiently accommodates pedestrian/ bicycle activity along the Southwest Corridor park at this point. In terms of traffic operations, future pedestrian and bicycle increased demand can also be adequately served by these pedestrian actuated signal controls.

Experience has shown that pedestrian overhead (and underground) structures are not well utilized unless at least one end of the walkway meets a strong destination point at the same level. In addition, Parcel 18+ Task Force meetings were held where strong sentiment was expressed that the use of pedestrian grade separation (such as overpasses or underpasses) was not desirable. For these reasons, pedestrian grade separation along Tremont Street and Ruggles Street adjacent to Ruggles Center has not been pursued.

6.2 Proposes improvement to traffic artery in the Blue Hill Avenue corridor to relieve traffic volumes on Columbus Avenue and Tremont Street.

The comment suggests improvements in other arterial roadway corridors (e.g. Blue Hill Avenue) to relieve traffic congestion along the Southwest Corridor facilities (Columbus Avenue and Tremont Street). The programming of improvements to different major arteries around the City in order to gain the most equitable distribution of traffic is a

public policy matter beyond the scope of this FEIR. The scale of trip making generated by Ruggles Center is not large enough to justify consideration of improvements in other traffic corridors other than those significantly affected by project traffic (Tremont Street).

The Commonwealth of Massachusetts
Executive Office of Transportation & Construction
Office of the Secretary

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Michael S. Dukakis
Governor
Frederick P. Salvucci
Secretary
and
M.B.T.A. Chairman

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MAR 25
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EOTC DEIR Comments on Parcel 18
Boston, MA
EOEA # 6133

The Executive Office of Transportation and Construction has reviewed the DEIR for the proposed Parcel 18 Development. The DEIR for this development proposes four build aternatives. The developers proposal consists 862,700 square feet with provisions for further expansion to 989,000 square feet.

Parcel 18 is one of the Southwest Corridor parcels which the MBTA and the City of Boston are working closly together to develop. The Executive Office Office of Transportation and Construction is highly supportive of this project due to its economic potential for the Roxbury community. In reviewing the DEIR document, EOTC would like to see the following issues discussed in greater detail in the FEIR:

1. The proponent is proposing to allow left turn movements only to the site for northbound Tremont Street and right out/right in movements from the site drive on Tremont Street. To accommodate these movements, signalization is being proposed at this
7.1 location. The proponent should discuss potential queue lengths for left turn movements and negative impacts that may result at the Tremont Street/Melnea Cass Blvd. intersection from insufficient capacity for southbound Tremont Street traffic.

2. Weaving conditions are likely to occur for traffic turning left from Melnea Cass Blvd. wishing to enter at the Tremont Street site drive and for "through" traffic on Tremont Street.
7.2 Impacts for these movements should be discussed in detail and appropriate mitigation outlined.

3. The proponent should analyze traffic impacts assuming no curb cuts on Tremont Street. This analysis should include levels of service for the Ruggles Street and Melnea Cass Blvd.
7.3 intersections with Tremont, Columbus Avenue site drive, and Ruggles Street Station access.

4. The report should better identify the location and describe
the proposed circulation pattern of any potential "Kiss and
Ride" access plan. Given the broad range of transportation
services to the site, the demand for this service should be
7.4 minimal. Any proposed plans in this regard should be properly
coordinated with potential MBTA "Kiss and Ride" access at the
Ruggles Street Station.

5. The DEIR lists multiple recommended traffic improvements as
being necessary without the project, the No-Build Alternative in
7.5 the DEIR. In the FEIR, the proponent should identify who is
responsible for each of these improvements and their expected
completion dates. Because the proponent's mitigation assumes
completion of these improvements, the FEIR should clearly
indicate what will happen if these measures will not be
completed prior to project opening. Should any or all of the
7.6 measures not be completed, the proponents' mitigation would be
inadequate or unrealistic. The FEIR should commit to a process
whereby the mitigation package and/or the project scope would be
7.7 adjusted to meet the new circumstances. EOTC recommends that a
Notice of Project Change be required if the assumed improvements
are not completed according to the anticipated schedule.

6. Given the percentage of traffic that will be generated from
I-93 and the Turnpike, the proponent should analyze traffic and
outline levels of service at major intersections on Melnea Cass
Blvd. between Tremont Street and Massachusetts Avenue.
7.8 Mitigation measures should be outlined for impacted
intersections.

7.9 7. EOTC questions the use of a 1% background growth rate. A
growth rate of at least 3% should be used in the traffic
analysis to insure that traffic impacts are not underestimated.

8. EOTC requests that the FEIR include a sensitivity analysis
7.10 for the parking needed to service the various alternatives. It
should clearly indicate what is likely to happen if
significantly less parking is available than the desired amounts
listed on Pages 100-103 in the DEIR. The analysis should
quantify likely effects of reduced parking scenarios, including
7.11 possible increased transit demand and the relative economic
viability of the land use alternatives.

7.12 9. Finally, we applaud the proponent for the comprehensive DEIR
discussion on Transportation Demand Strategies. It is expected
that these measures will be included in the mitigation
commitments in the FEIR. A time frame for implementation for
these Transportation Demand Strategies should be outlined in the
FEIR.

7.0 Executive Office of Transportation and Construction

Comments From: Cheryl Soon
Dated: May 24, 1989

7.1 Wants further discussion of traffic capacity and queue length impacts that could be caused by allowing north-bound Tremont left turns into site.

Further discussion is presented in the FEIR regarding the analysis of queue lengths and their impacts on traffic operations at the intersections adjacent to the Ruggles Center site. See Chapter II, Section A, Ruggles Center Access Option - Queuing Analysis, as well as Table II A-22.

7.2 Impacts of weaving traffic on southbound Tremont Street operations between Melnea Cass Boulevard and the site driveway should be discussed.

The potential number of vehicles subject to weaving to the Ruggles Center site entrance along the Tremont Street southbound approach is small, approximately 57 vehicles during the morning, 20 vehicles during the evening and 18 vehicles during the Saturday peak hour periods. In addition, most vehicles travelling westbound on Melnea Cass Boulevard destined for the site entrance along Tremont Street will make the turn from the middle lane of Melnea Cass Boulevard (signed for straight/left turn) into the right lane of Tremont Street as traffic destined for Ruggles Street does today, thereby avoiding this weaving movement.

7.3 An access alternative with no site access for vehicles to or from Tremont Street should be analyzed.

Three access alternatives for the Ruggles Center site have been identified and analyzed for the FEIR, including no site access to or from Tremont Street. Refer to Chapter II, Section A, Traffic Impacts - Master Plan Design for response to this comment.

7.4 MBTA and site access "kiss and ride" should be coordinated.

As the commentor noted, the demand for dropoff/pickup activity to the Ruggles Center development is likely to be minimal. Preliminary site plans for the development incorporated dropoff areas along Tremont Street and Ruggles Street. Discussions with the City and the MBTA, however, eliminated all curbside dropoff/pickup and parking activity along the roadways adjacent to the site (Tremont Street, Melnea Cass Boulevard and Ruggles Street).

The MBTA "kiss and ride" area, located in front of the station entrance, has space for two vehicles. Low demand is currently evident due to the extensive feeder bus and other transit service available to the site. A survey by Howard/Stein-Hudson indicated that during the morning peak hour, 27 vehicles picked up or dropped off 30 passengers. In the evening peak hour, 36 vehicles picked up or dropped off 47 passengers. Two employers, Stride Rite and Boston City Hospital, provide shuttle vans that service the station approximately every 15 minutes during the weekday peak periods.

Under the Master Plan Design, a kiss and ride drop off area with space for three vehicles is also located in front of the hotel. This area will be signed for use by the hotel and supervised by hotel staff. The provision of two lanes in the site will also allow for vehicles to stop and pickup or discharge passengers at other locations in the development.

7.5 Identify schedule and parties responsible for assumed No Build improvements.

The major roadway improvement to serve the No Build traffic increases is the widening and other operational changes for Ruggles Street, between Tremont Street and Huntington Avenue. These are now under design by the MBTA with the support of the City of Boston Transportation Department and the State Executive Office of Transportation and Construction. Through Boston Metropolitan Planning Organization funds, these agencies are seeking under the Federal Urban Systems program a possible completion in 1993.

The No Build roadway improvements identified as required in the DEIR along the Tremont Street corridor south of Ruggles Street at the intersection of Tremont/Prentiss and Tremont/New Dudley Street/Columbus have already been implemented by the City. Pavement restriping enabled the use of a breakdown lane as a travel lane and effectively increased the number of lanes in use along this portion of Tremont Street from two to three lanes in both directions. The traffic analysis in the Final EIR assumes these roadway improvements for

existing, No Build and Build conditions.

Responsibility for improvements at the intersection of Tremont Street and Melnea Cass Boulevard for No Build conditions has not yet been identified, although discussions are underway with the public agencies involved. Additional improvements above those identified as necessary under No Build conditions will be required at this location when Ruggles Center is completed. The Ruggles Center proponent is involved in helping to establish the best design for Build conditions, as this FEIR shows, and will cooperate in identifying improvement funding sources for this location. These improvements will also fulfill the requirements of the No Build traffic conditions, and presumably the developers of these projects will also become involved in the process.

7.6 Clearly indicate what will happen if these measures will not be completed prior to project opening. Adjust mitigation package to meet the new circumstances.

Comments received on the DEIR expressed concern about how the project would respond if identified traffic improvements were not realized (Ruggles Street corridor from Tremont Street to Huntington Avenue). Due to the commitment of sponsoring agencies, however, it appears very likely that Ruggles Street improvements will be made. In addition, the extended period of project implementation to 1996 will allow ample time for the development of roadway improvements.

For more information, refer to Chapter II, Section A, Summary and Responsibility for Mitigating Measures.

7.7 Recommends Notice of Project Change if assumed improvements not achieved.

Refer to response to comment 7.6.

7.8 Analyze traffic impacts on major Melnea Cass Boulevard intersections from Tremont Street to Massachusetts Avenue.

In discussions with the MEPA Unit and EOTC, the intersections of Melnea Cass Boulevard with Washington Street and Massachusetts Avenue have been identified for traffic operations analysis in the FEIR. Project traffic does not bring operations at either location to unacceptable Levels of Service (LOS). See Tables II A- 2 , II A-17, II A-18, and II A-19 for specific LOS indicators.

7.9 Questions background traffic growth rate.

The reviewer assumes the background traffic growth rate as described in the DEIR is only 1%. Documentation of expected traffic growth within the study area has been rewritten in the FEIR to clarify the overall methodology of the approach. (Refer to Chapter II, Section A, No Build Traffic Forecast for a complete documentation of the No Build expected traffic increases.)

The total growth rate is composed of both general background and identified other project growth, amounting to over 14%, or around 1.75% annually over the eight years between 1988 and 1996. This rate appears adequate both from the analytical approach of this study and is higher than that used for the State's (MDPW) own Central Artery work.

For the region (Central Artery/Third Harbor Tunnel Cordon), the MDPW uses a traffic growth rate of less than 1% per year from 1987-2010. The rate at the nearest location to Ruggles Center, on Columbus Avenue north of Massachusetts Avenue, is 2.0% northbound and 1.1% southbound. Furthermore, the MDPW traffic growth rate for the area includes the Ruggles Center development.

A meeting was held between the developer's consultants and representatives of the MBTA and EOTC on August 1, 1989 for the purpose of explaining the methodology used in the development of growth rates. The meeting resulted in agreement by those present that the FEIR traffic growth rates were reasonable.

7.10 Requests a sensitivity analysis for parking needs.

In a parking sensitivity analysis, the primary question is not how much modal shift will occur, but rather whether the marketability and viability of the development uses will be affected. The standard parking ratio for suburban office space is 3 spaces per 1,000 square feet. In Boston's downtown, with its good transit service, however, a parking ratio of one-half space per 1,000 SF (square feet) is appropriate. At Ruggles Center, which enjoys good transit service but is not as well served as downtown, a ratio of 1 space per 1,000 SF is reasonable.

Overall in Boston Proper (Boston peninsula north of Massachusetts Avenue), it is of note that the actual offstreet parking available on average to all commercial properties is close to one space per 1,000 SF. Development demand has remained high in Boston Proper.

7.11 Discuss impacts if parking supply significantly less than demand indicated by trip generation.

The Master Plan Design has a total gross floor area of about 970,000 SF and a proposed parking supply of 975 spaces, or around one space per 1,000 SF. Parking demand estimation using the trip generation numbers produces a demand of about 1,225 spaces. As stated in the text, the Urban Land Institute method (based on standard parking floor space ratios) yields a parking demand of 941 spaces, closer to the 1 space per 1,000 SF. At this ratio, the 975 parking spaces proposed will be sufficient to market the space. However, a modal shift would be necessary to bring down the demand estimate according to the trip generation.

It should be observed that if unlimited parking is available at low cost and no transit encouragement is given, the majority of people would choose to drive. In the real world of conflicting interests, however, a balance has to be achieved between modes. There are space and cost limitations on parking, management and pricing factors. Also present is the need to reduce traffic congestion and air pollution and to foster alternative travel modes.

As a general proposition, it is expected that if enough parking is not available, or if the price is too high, two things can happen: another access mode (carpool, transit, bicycle or walk) will be taken instead of driving; or the trip will not be made. Given the excellent transit service afforded to Ruggles Center, transit is an extremely viable alternative to driving.

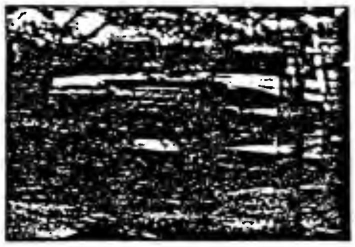
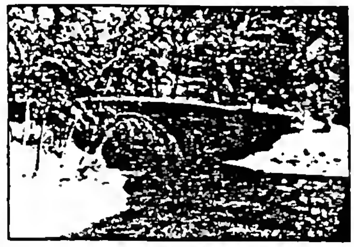
7.12 Include Transportation Demand Strategies in the mitigation commitments.

The developer is firmly committed to implementing the transportation demand management strategies outlined in the DEIR and again in the FEIR. As discussed in the text, various strategies can be employed throughout the leasing process until the buildings are fully tenanted, when the transportation management function becomes part of ongoing building management and employer personnel policies.

To some extent, the way in which demand management is carried out will depend upon the types of tenants. Large employers are capable of implementing many strategies on their own (ie. payroll deduction for transit passes or rideshare matching services). Smaller tenants may depend on building management for such services. Even

the types of tenants can affect transportation demand. For example, research and development firms typically require more floor space for labs, equipment, etc. than other uses, thereby lowering trip generation and parking demand per square foot.

At this early stage, the developer has been actively promoting the excellent transit access in terms of seeking tenants. In addition, meetings are continuing with the City of Boston and the MBTA on other strategies as the development progresses.

RICHARD HEATH

P Chan

April 14, 1989

Ms. Pamela Wessling
Boston Redevelopment Authority
City Hall
Boston, MA 02201

Dear Ms. Wessling:

I attended the Parcel 18 Draft Environmental Impact Review Meeting on April 12, 1989. My primary reason for attending was because of my long-time involvement in the design, construction and now the management of the Southwest Corridor Park.

I wish to comment on the Parcel 18 proposals in its relation to the new Park.

All of the proposals will have a negative impact and detrimental impact on the Park. The Park is already very tenuously connected to the South End as it is, to the point of being almost two distinct parks after Carter Playground. The Parcel 18 proposals will for all intents and purposes break the chain of the new Park. The proposals are all much too dense for that site.

All the Parcel 18 proposals will create an enormous traffic barrier which will divide the park from the Lower Roxbury Community. Traffic as it is, now, makes it difficult for residents of the Whittier Street Development and Madison Park Village to get to the Park.

All the proposals will make it all but impossible to go from the Ruggles Street Station link of the Park to the opposite side of the street where the Mission Hill Amphitheater has been built near the tennis courts. Traffic today is difficult and hazardous enough for the young and healthy. It is impossible today for the small, the infirm or the elderly. When residents return to the new housing at Mission Hill in May, they will have to negotiate a dangerous traffic pattern to get to their bus or train or to go over to Carter Playground.

Shadows and winds will be detrimental. The area is flat and takes the brunt of north winds as it is. All the proposals will increase the shadows and the wind on the new park.

The answer is to mitigate these negative and detrimental impacts because something will be built at Parcel 18. I daresay that not one resident in Mission Hill or Whittier Street or even one parishioner of St. Cyprians or St. Francis de Salles Church will be prepared for the upheaval which Parcel 18 will create. The discussion so far has been economic benefit, but I believe the cost for that benefit to the

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RICHARD HEATH

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area residents (dubious at best) will be too much for them to bear.

The scale of the development cannot go any higher than 5 stories and parking will have to be limited. There is a saturation level in
8.1 any project and the Ruggles-Cass-Tremont district has almost reached it now in terms of traffic.

Secondly, the project must shift emphasis to how it can be less an
8.2 obstruction to the communities. Erection of flyovers or subways on Ruggles Street and Tremont Street for pedestrians is the answer along with well marked and highly visible pedestrian avenues at grade on both roads with pedestrian lights sympathetic to the person on foot. Buses should be routed under ground if possible. Now is the opportuni
8.3 to consider an underground busway through Parcel 22 to the below ground busway of Ruggles Street Station. Ruggles Street cannot be widened any further. I don't believe the answer to traffic congestion is creating more lanes for more traffic. Traffic should be discouraged and Mass Transit encouraged. If Parcel 18 is truly for the benefit of Roxbury, then Mass Transit will be used.

Although, peripheral to Parcel 18, Melnea Cass Blvd. at present is a barrier for people from Madison Park Village and Whittier Street to get to Ramsey Park or simply to get to Sterling Street or go to
8.4 Church on Lenox Street. A flyover should be built to connect these two neighborhoods together with well marked, highly visible pedestrian lights and walks.

Many people fought hard and long to stop the Inner Belt. They won; or they thought they won. What I heard on Wednesday night from Mr. Howard et al was another version of the Inner Belt that will divid and isolate the East Fens from Lower Roxbury.

Although, perhaps not under your area of responsibility, I see a similar future for Jackson Square: division of the communities by wall of traffic, impossible if not dangerous access between Marcella Playground and the recreation ground of the Southwest Corridor Park at the Bromley Heath Development, and finally, dangerous passage to the transit system itself.

I would caution you to recall, that the communities which exist today were built as low scale residential communities along low scale retail streets that no longer exist. The main streets have been

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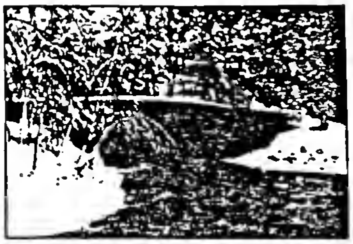

RICHARD HEATH

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ripped off from the cityscape, but the residential communities remain. The economic benefit of the redevelopment of the redundant land of the Corridor must take the needs of the existing residents into consideration first. Quality of life is first and foremost in my view.

I believe there is ample opportunity to mitigate the enormous impact of Parcel 18 on its community by the suggestions provided of flyovers, pedestrian subways and broad,bright, well lit pedestrian avenues to bring the residents of Lower Roxbury to their new transit system, to their new Park and to their neighbors across the street.

Respectfully,

Richard Heath

RH:mlh

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8.0 Richard Heath

Dated: April 14, 1989

8.1 States strong concern on the barrier effect of site area roadways.

Mr. Heath expressed concern over the effect that major roadways in the area could have on pedestrian movements between communities and activity centers.

Physically, some widening and other geometric changes are proposed to serve future traffic, but these will not alter the overall scale of the roadways involved. Increases in roadway width are proposed for Melnea Cass Boulevard between Tremont Street and Columbus Avenue. This roadway will remain within a similar envelope, but will be widened along the eastbound approach to afford three travel lanes. Tremont Street between Ruggles Street South and Melnea Cass Boulevard will be widened by approximately 20 feet. Ruggles Street between the Busway and Parker Street will be widened to a cross section similar to the Ruggles Street approach to Tremont Street.

Pedestrian actuated signals will be maintained at all signalized intersections, including a pedestrian crossing across Tremont Street at Ruggles Street South. These crossings are positioned about every 400 feet in the general area of Ruggles Center. In addition, Ruggles Center is being designed to provide optimum access to pedestrians and bicycles, recognizing points of conflict with vehicles. It is felt that the various measures being taken will restrain any roadway barrier effect.

8.2 Pedestrian grade-separations are recommended for Tremont and Ruggles Streets.

Refer to response to comment 6.1.

8.3 Consider an underground busway through Parcel 22, linking to underground busway of Ruggles Station.

Refer to response to comment 6.1.

8.4 Proposes a pedestrian overpass from Madison Park Village and Whittier Street to Ramsey Park and Lenox Street.

It is assumed that the commentor is proposing a pedestrian overpass at Melnea Cass Boulevard in the vicinity of Shawmut Avenue. The existing pedestrian actuated crosswalk signals at Melnea Cass Boulevard and Shawmut Avenue are adequate to handle current and future pedestrian demand at this location. (The issue of pedestrian grade separations in the Southwest Corridor are discussed in detail in response to comment 6.1.)

8.5 More encouragement of transit should be emphasized rather than roadway widenings.

The strong relationship Ruggles Center has to the transit system is recognized throughout the report. The percentage of trips generated to and from Ruggles Center that are expected to use transit is higher than that of the surrounding area. This assumption is the result of Ruggles Center being directly adjacent to a major rapid transit facility served by feeder bus routes and commuter rail. In addition, the developer is and will continue to incorporate the excellent transit access into marketing strategies for the site and lease agreements.

TO: Pamela Wessling

FROM: Brenda Butler-Hamlett

RE: DEIR Comments from Parcel 18

DATE: May 12, 1989

The following are comments from the Parcel 18+ Task Force:

I. Traffic:

A. What is the overall impact on
9.1 1. Hammond/Tremont Streets and Hammond/Shawmut Avenue intersections?
2. traffic flow from
9.2 a. Egleston to Mass. Avenue?
b. Ruggles to Mass. Avenue?

9.3 B. What studies have been done to demonstrate the impact of synchronized signal lights from Egleston Square to Mass. Avenue?

9.4 C. The DEIR report should include a map that shows traffic from Egleston to Mass. Avenue.

9.5 D. In relation to Franklin Park Zoo, what is the overall traffic impact of peak seasons for the zoo, particularly in the wake of its "grand opening?"

9.6 E. It is extremely disrespectful that no mitigation measures are considered necessary because this DEIR indicates that the increase of CO emissions isn't enought to warrant action. I am appalled that this community continues to be characterized in such a way that it isn't important enough to warrant mitigation action for the slightest increase of CO to its already polluted environment. Any negative increase to the air quality of this community warrants mitigation. Please note that other developments are forthcoming along the Southwest Corridor; we ask that all be responsible for any and

all pollutants to the air quality of this community caused by each project development and have appropriate measures of mitigation.

9.7 F. It would seem that some plan/design would demonstrate concern for pedestrians on both the Ruggles Street and Fremont Street crossing.

1. An overhead walk way, handicap accessible, well lit and visible on both streets would be appropriate.

II. Utilities:

A. What will happen to Whittier Street Housing if the Roxbury Puddingston is hit?

1. Who will bear the responsibilities for repair?
   a. who will monitor?
   b. who will be responsible for relocating families if necessary? 9.8

B. Who will the engineering monitors be?

1. how often?
2. who enforces?
3. what are the sanctions?

9.9 C. Who will monitor the water drainage?

1. how often?
2. who enforces?
3. what are the sanctions?

9.0 Parcel 18+ Development Task Force

Comments From: Brenda Butler-Hamlett
Dated: May 12, 1989

9.1 Describe overall traffic impacts on Hammond Street at Tremont Street and Hammond Street at Shawmut Avenue intersections.

Vehicle trips generated by the Ruggles Center development account for less than 3% of total traffic volumes (approximately 27 vehicles) approaching Hammond Street along Tremont Street during the critical evening peak hour period.

Traffic signals at an intersection are justified if one or more of the eleven signal warrants (criteria), as described in the Manual on Uniform Traffic Control Devices for Streets and Highways, are met (see Appendix J). The City of Boston produced a report in 1988 regarding the installation of traffic signals at the intersection of Tremont Street and Hammond Street. The data analyzed covered the hours of 7:00AM to 6:00PM for September 8, 1987. The report concludes that the installation of traffic signal control at this location is not justified since none of the eleven signal warrants is met.

Ruggles Center will not impact the Shawmut Avenue intersection with Hammond Street since project trips are not expected to travel through this location.

9.2 Describe impacts on traffic flow from Egleston to Massachusetts Avenue and Ruggles Street to Massachusetts Avenue.

Traffic operating conditions (Existing, No Build, and Build) along Tremont Street from New Dudley Street to Melnea Cass Boulevard are identified in the FEIR. The intersection locations analyzed encompass the majority of the intersections along the corridor between Egleston Square and Massachusetts Avenue. Trips generated by the Ruggles Center development account for less than 3% of total traffic along Tremont Street north of Melnea Cass Boulevard and Columbus Avenue south of New Dudley Street. In addition, when combined with the additional traffic approaching Tremont Street at intersection locations beyond Melnea Cass Boulevard and New Dudley Street, the

percent of total traffic at an intersection as a result of the Ruggles Center project is even less.

9.3 Identify studies done to assess impacts of synchronized signals from Egleston Square to Massachusetts Avenue.

There have been no studies done to assess the impacts of synchronized signals from Egleston Square to Massachusetts Avenue. The City of Boston is, however, currently installing a citywide signal coordination system which includes part of this corridor. In addition, intersections surrounding the project at Tremont/Ruggles/Whittier; Tremont/Melnea Cass; and Columbus/Melnea Cass will be designed for coordinated functioning under the Build mitigation proposal.

9.4 Include a map that shows traffic from Egleston to Mass. Avenue.

As mentioned in the response to 9.2, the Ruggles Center development does not contribute significantly to traffic volumes in the Tremont Street corridor between Egleston Square and Massachusetts Avenue beyond those identified in the traffic impact section of the report. In addition, many of the intersection locations along this corridor are included in the analysis.

9.5 Identify traffic impact during peak seasons for Franklin Park Zoo.

The most direct route from Ruggles Center to the Franklin Park Zoo is approximately 2.5 miles along Tremont Street, Columbus Avenue and Seaver Street. The traffic impacts associated with the Franklin Park Zoo operations are not expected to impact the same intersection locations as those identified as critical for the Ruggles Center development, due mostly to the lack of proximity of the two facilities. In addition, the peak traffic hours for zoo operations are expected to occur at times other than the peak traffic hours identified at Ruggles Center, with the exception of the non- critical Saturday peak hour period.

9.6 Asks that all developments be responsible for any and all pollutants to the air quality of the community caused by each project development and have appropriate measures of mitigation.

The DEIR states that the "increase in CO emissions due to the proposed development ... is not predicted to exceed the NAAQS for

either the one-hour or eight-hour CO concentrations at any of the ten sensitive receptor locations for any of the alternatives examined." The primary source of air pollution in the study area is from motor vehicle pollutant emissions.

The analysis in the DEIR assumes that all roadway improvements indicated as necessary to provide acceptable traffic operations in the 1993 traffic analysis year have been implemented. These roadway improvements are the mitigation for air quality degradation due to traffic congestion.

The traffic analysis in the FEIR uses a downscaled development proposal, the Master Plan Design, as the build alternative. The Master Plan Design generates 4,279 average daily vehicle trips, a reduction of 1841 vehicle trips (30%) from the "19 story office building" alternative, the "worst case" alternative examined in the DEIR. This alternative generated 6,120 average daily vehicle trips. As such, air quality impacts in the study area due to the Ruggles Center development are expected to be less than those previously assessed for the alternatives analyzed in the DEIR. In addition, at the two intersection locations added to the traffic impact analysis (Melnea Cass Boulevard at Washington Street and Massachusetts Avenue), Level of Service remains at D or above during all time periods studied.

9.7 Proposes pedestrian overpasses for Tremont and Ruggles Streets.

Refer to response to comment 6.1.

9.8 Identify engineering monitors, frequency of monitoring, sanctions, parties responsible for enforcement.

The project proponent will see to it that all work done in connection with construction of Ruggles Center meets local, state and federal standards for safety. The purpose of the FEIR and Section 61 Findings is to establish mitigation measures which minimize the adverse impacts of this project and to identify parties responsible for mitigation. In addition to the FEIR, all levels of government, through a rigorous permit and approval process, will effectively monitor the development of Ruggles Center.

9.9 Identify party responsible for monitoring water drainage, frequency, sanctions, enforcement policies.

It is the responsibility of the architect and the site engineers to ensure that the building design provides for proper water drainage. In addition, the standard building insurance, maintained by the owner, will cover the cost of repairs should they be necessary. It is the building owner's responsibility on a long-term basis to keep drainage areas clear.